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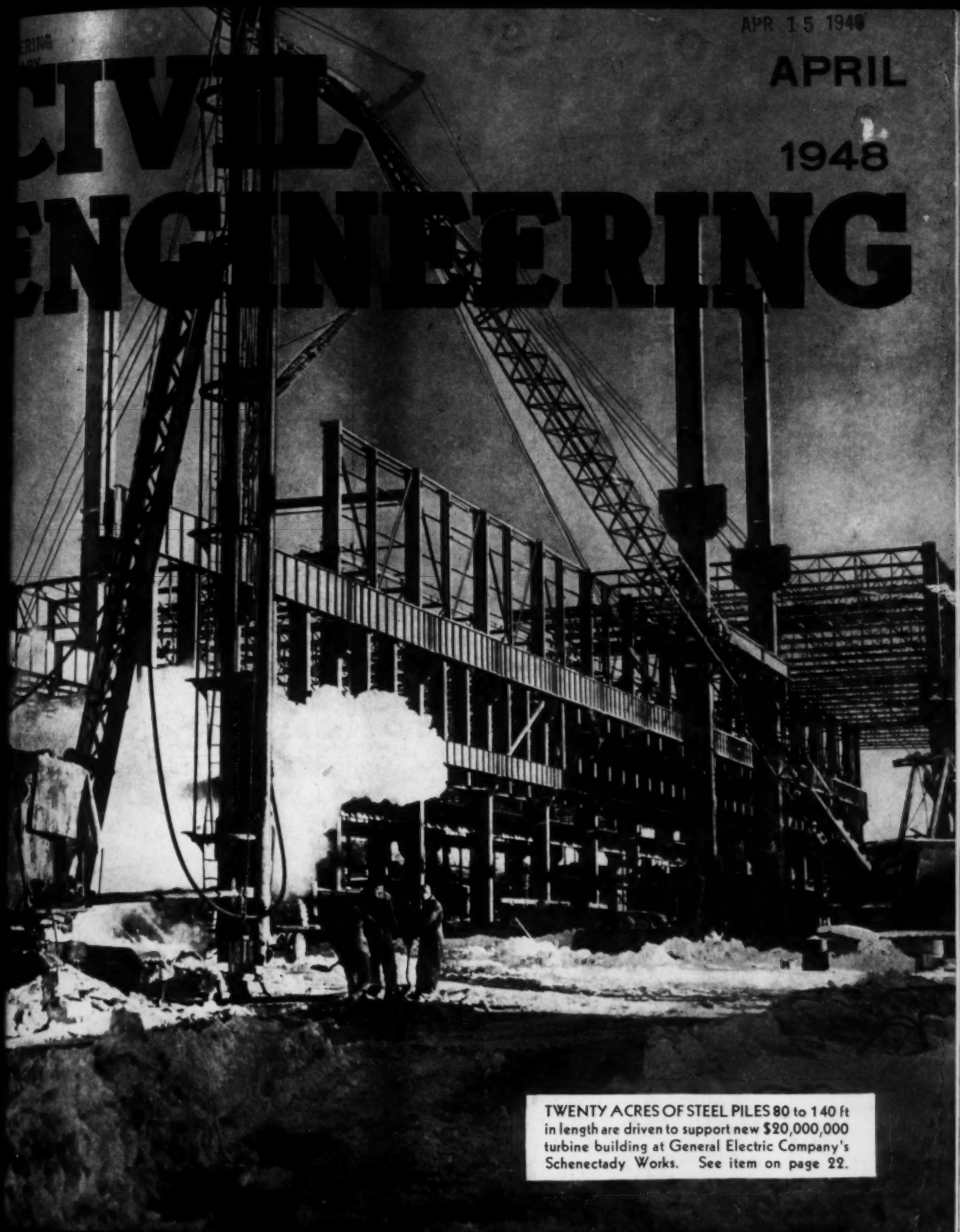
CIVIL ENGINEERING



TWENTY ACRES OF STEEL PILES 80 to 140 ft in length are driven to support new $20,000,000 turbine building at General Electric Company's Schenectady Works. See item on page 22.

ECONOMIES [illegible] PLAY IMPORTANT
ROLE IN CONTROLLING POWER COSTS
Steam-Electric Power—E. H. Krieg, L. Elliott, W. F. Ryan
Hydroelectric Power—[illegible] Salzman, G. R. Strandberg, L. F. Harza and J. I. Metcalf

CHINA REBUILDS HER RAILROADS—P. C. Lee

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RECENTLY COMPLETED Anderson Ranch Dam in Idaho —world's highest earthfill structure, containing approximately 9,000,000 cu yd of material—will provide supplemental supply of water for 320,000-acre Boise Project. Designed by Bureau of Reclamation and scheduled for completion in 1946, project was delayed by wartime material and labor shortages. Information in this item is from the Morrison - Knudsen Co., Inc , publication, *The Em Kayan*.

Highest Earth Dam Nears Completion

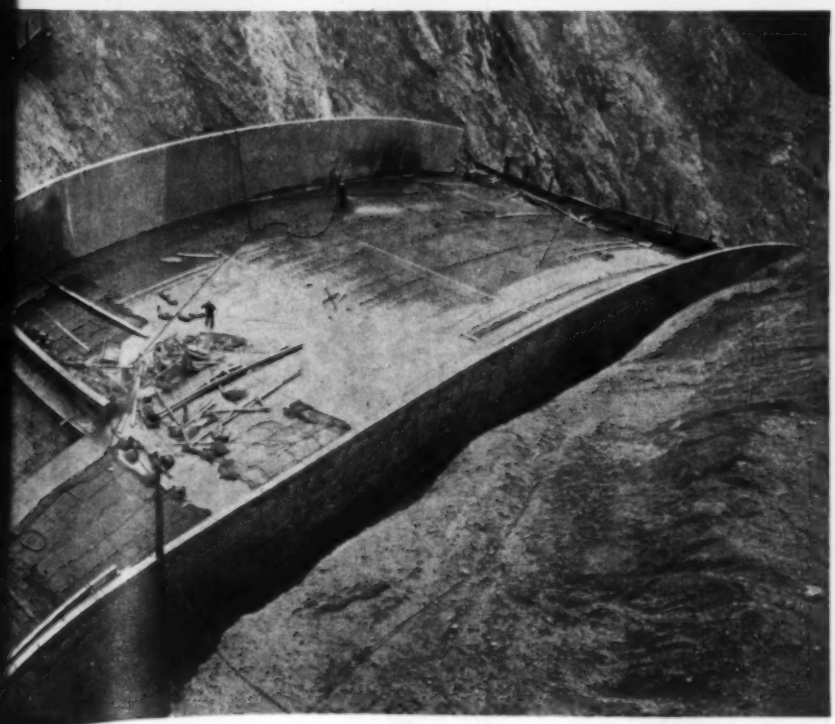
OMPLETION OF the 456-ft embankment containing approximately 000,000 cu yd of clay core and rock pes marks the closing stages in nstructing the world's highest earth m, Anderson Ranch Dam in Idaho. ork is still in progress on the conete spillway, a 304-ft-high and 1,195-long structure. A 40,500-kw powerant is yet to be built and the outlet rks are to be completed.

Added to the natural problems inrent in the dam's mountain locaon, the Anderson Dam project was set by many wartime and postar obstacles. A recent press release by the Bureau of Reclamation sums up briefly the hectic story of the huge irrigation structure thus:

"Construction of the dam was begun in August 1941, by the present contractor, Morrison-Shea-Twaits-Winston Company. The original scheduled completion date was April 24, 1946. Despite material and labor shortages due to the war, the contractor pushed work vigorously until December 1942, when, with the structure one-third completed, the War Production Board issued a stop-order to divert critically needed materials to war purposes. The stop-order was modified on October 6, 1943, on the recommendation of the War Food Administration, which felt the project could make a sizable contribution to war food supplies if completed in time. Limited construction was permitted for some time thereafter.

"Manpower shortages and inability to obtain certain materials and equipment have proved troublesome throughout the late construction operations. Lack of adequate appropriations stopped the work for approximately six months during the early part of this year."

RGE WATERFALL, approximately 304 ft high, will soon start its plunge over crest of spillway at Anderson Ranch Dam (below, left). Openannel, concrete lined chute about 100 ft wide at toe, has capacity of 20,000 cfs. Situated on left abutment of dam, spillway will carry th fork of Boise River during periods of overflow. View upstream (below, right) shows drilling operations in stilling basin (foreground).



Progressive Engineering Offsets Increased Costs of Steam-Electric Power Generation

EDWIN H. KRIEG

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INCREASES in almost all component costs of steam-electric power generation, not only in constructing plants but also in operating them, challenge solution. The problem of reducing plant investment costs is absorbing the attention of construction and design engineers. And, no less, operating engineers are grudging each ton of coal going into the furnaces, and bending every effort to keep equipment on the line. Cost indexes show that steam-electric plant costs have already increased some 63 percent, and operating costs have risen about 51 percent through increased fuel costs and higher wages for plant operators. Increased investment and operating costs can only be partly compensated for by reducing the controllable elements of investment and operating costs, and some examples of each are given herein. This article, based on a paper presented before the Power Division at the ASCE Annual Meeting, discusses ways in which progressive engineering can control first costs and operating costs. Discussions of this paper by William F. Ryan and Louis Elliott are also published herewith.

THERE IS AMPLE EVIDENCE of the fact that prices have gone up, but data are needed to show how *much* plant costs have risen so that the urgency and seriousness of the problem facing the electrical industry may be properly assessed. Curves show trends so much more clearly than does text that the delineation of the problem had better be accomplished by the accompanying figures and their explanatory captions. In the series of graphs Figs. 1 to 5 inclusive, present costs are compared with past costs.

Figure 1 shows an increase of 57 percent in total 19 American Gas and Electric system costs over 1940, steam-electric plants, transmission, distribution a general. Some components of this total are shown the three curves in Fig. 2.

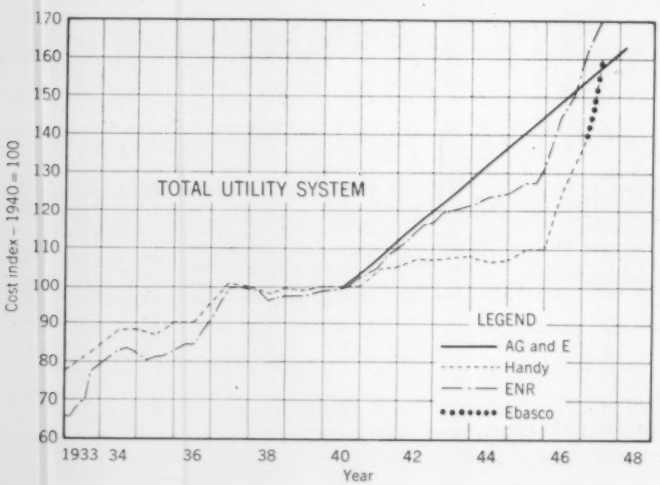
The American Gas and Electric cost figures in th paper were developed during the summer of 1947 and do not reflect any changes that have taken place since the

Reasons for Higher First Costs

To judge the *extent* of the present upward trend as to judge how much *further* it will go and how *long* it w tarry, the reasons for the higher costs should be examine No doubt a long list could be made of the many reasons and factors that contribute to the decreasing value of th dollar and the concomitant higher costs, such as: Large national debt, wage increases, overtime, lower labo efficiency, delivery delays, material shortages, higher material costs, and what not.

Higher operating costs naturally warrant higher-co equipment in order to attain "bottom-of-the-curve" over-all costs. Neither the first cost nor the operating cost should be the "lowest"—it is a combination of th two that should be the minimum. It is true that higher fuel costs have made it economical to install higher pressure and higher-temperature equipment, which naturally costs more, but not so very much more Higher wages for operating labor justify labor-saving de vices and mechanization of disagreeable tasks, such as as handling. Higher maintenance labor rates naturally ca for more rugged equipment that is not so likely to brea down, not only causing an outage but often requir ing overtime labor and expensive material.

FIG. 1. WEIGHTED HIGHER COST in 1947 of 57 percent for all electric utility system costs is obtained by multiplying 1947 increase over 1940 by distribution of various accounts as tabulated below. Increase of 57 percent in 1947 costs over 1940 appears conservative as corresponds with 71.5 percent ENR index as of August 1, 1947.



Plant Account	% of Total Utility System	% Cost Increase '47 over '40	% Cost Increase '47 Over '40 on Total System
Steam-electric plant	34	63*	21.4
Transmission line and substations	27	46*	12.4
Distribution	35	55*	19.3
General	4	95	3.8
	—	* See Fig. 2.	—
Total system	100		56.9

The *Engineering News-Record* and Handy indexes primarily measure prices of component parts, not the completed structure. Actual costs of an erected structure are higher because of:

1. The fact that young, strong men went to war. Many of the replacement men were older and sometimes less skilled.
2. Job delays on account of material shortages, longer deliveries, and sometimes jurisdictional troubles between unions.
3. The advent of inexperienced men in construction work during the war period.
4. Overtime as an inducement to stay on a job.

Engineering News-Record, April 1947 (p. 92), lists other reasons

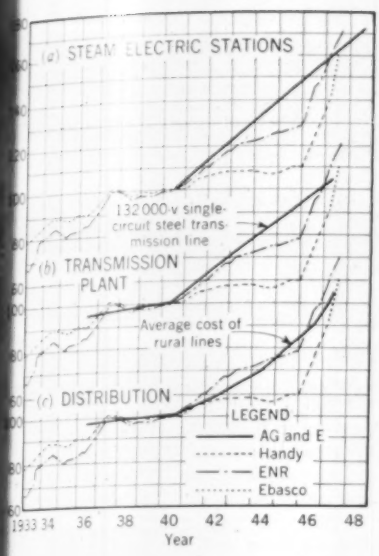


FIG. 2. THREE CURVES (a), (b) and (c), are components of Fig. 1. Contributing to 63-percent increase in steam-electric plant costs are:

	1940	1947	%
Structures (see Fig. 3)			
Turbines	100 (base)	145.4	45½
Boilers	100 (base)	132.5	32½
Structural steel (¢/lb)	6.0	9.32	55
Brick ($/M)	21	33	57

	1940	1947	%
Bricklayers ($/hr)	$1.70	$2.00	17.7
Carpenters ($/hr)	1.25	1.875	50.0
Steelworkers ($/hr)	1.74	2.15	22.9
Common laborers ($/hr)	0.625	1.00	60.0

Transmission-line costs have increased 55 percent over 1940. Some of the component increases are:

	1933	1941	1947
Tower material (¢/lb)	2.75	4.48	7.10
Aluminum conductor, steel reinforced (¢/lb)	9.75	17.31	20.00

	1933	1941	1947
Insulators ($/ea.)	1.576	1.16	2.36
Labor ($/hr)	0.30	0.60	1.00
Linemen ($/hr)	0.55	1.00	1.85

Combination of transmission-line and substation costs is up 46 percent. Distribution plant costs are up about 55 percent. The curve is for rural distribution. However, an underground system in an average city block would cost $42,900 in 1941, $62,000 in 1946 (up 42½ percent) and $70,600 in 1947 (up to 65 percent over 1941).

The matter of properly evaluating availability, from the standpoint of reducing maintenance material and labor costs and running uneconomical equipment during the outage, is now receiving more widespread attention. The three components of operating cost of steam-electric plants are:

	Approx. % of Total Cost	% Increase Since 1940	Weighted Average
Fuel	70.3	53	37.5
Operating labor	14.5	59	8.6
Maintenance	15.2	30	4.5
Total			50.6

Fuel. Figure 6 shows the cost trend of fuel. The balance of prices versus demand was seriously upset by the export of almost 60,000,000 tons of coal in 1947. The U.S. Government in granting credits to foreign countries who are then free to enter our coal market in competition with the steam-electric plants of utilities. The export of three times as much coal as normally, naturally creates a shortage of coal cars, since all the exported coal must be shipped to tidewater.

Labor. The 1946 average monthly earnings of employees of the electric power and light industry have risen 39 per cent over 1939.

Maintenance. Maintenance costs comprise both material and labor. Both have gone up, perhaps to the extent shown in Fig. 4 if the usual amount of time can be allowed for outages and overhauls. But generating capacity being short, outage time must be minimized, which necessitates the extra cost of overtime work. In spite of higher load factors, which greatly improve the situation by providing more kilowatt-hours per kilowatt of capacity (Fig. 8), maintenance has risen at least 30 percent.

Will Costs Stay Up?

There is reason to believe that the price level attained during and after World War II will be retained, following a pattern similar to that which became permanent after the Civil War and World War I. The general shapes of the curves for the three wars are quite similar (Fig. 7).[3]

After World War I, the price peak was 251 percent above its prewar level. A plateau was finally reached at about 82 percent (206) of the high peak (251). On this assumption the present price trend should reach a final level at perhaps 375. This means a final cost level of perhaps 60 percent over 1940, depending on where costs will stabilize between today's levels and the peak levels. Since the *Engineering News-Record* index used in Fig. 7 is based on material costs and wage rates only, it does not reflect the higher level caused by overtime, lower labor efficiency, delivery delays, and untrained labor. The 60-percent higher level is on the assumption that increases from such causes will eventually disappear. The writer wishes to emphasize that these figures are *not* a prophecy, and that the reader is encouraged to substitute his own prognostications. We may have been only climbing the foothills of prices while the peak is still far above.

Reducing First Costs

Rather than deploring present high investment costs, let the emphasis be placed on how they may be reduced, only studying the reasons for the high

*See bibliography, page 18

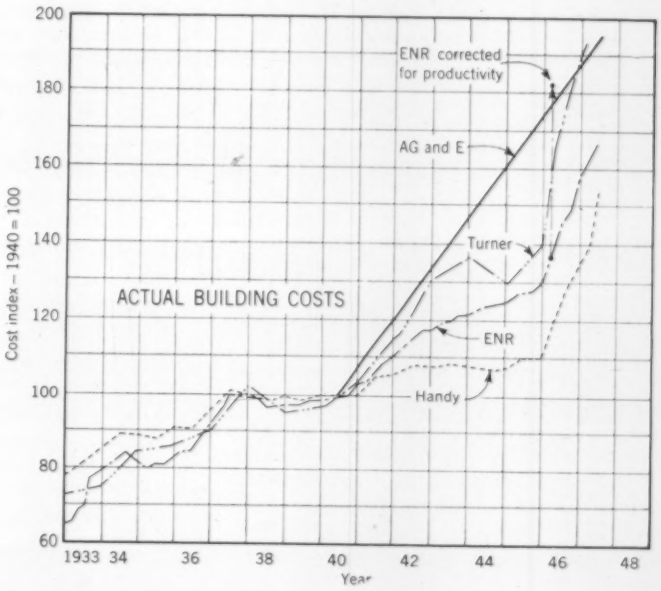


FIG. 3. GENERAL STRUCTURE costs have increased some 95 percent. Handy and ENR indexes do *not* reflect increased costs caused by low labor efficiency, overtime, etc. *Engineering News-Record*[3] gives data showing 1947 productivity only 66 percent of that in 1939. Correcting ENR curve for productivity gives index of 216 instead of 164 for April 1947, and 182 instead of 138 for April 1946. Turner Construction Co. applies its own experience with these factors to its curve[3]: labor rates, material prices, labor productivity, efficiency of plant and management and competitive conditions. This index is 195 as against 167 for ENR index.

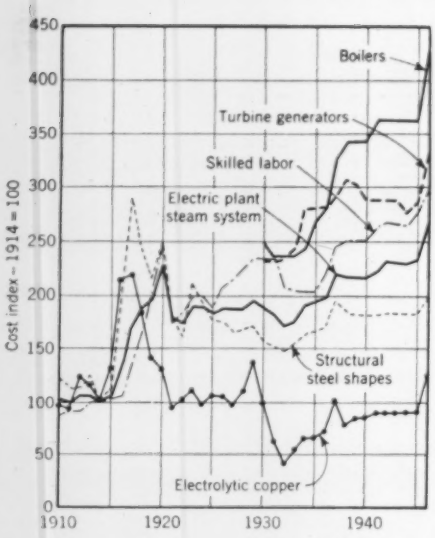


FIG. 4. CURVES (by W. F. Ryan) show cost increases of various generating-plant components since 1910.[1] If common-labor curve were shown, it would run off at about 1938—it is now over 600. Only reason powerplants do not cost four times as much as in 1914 is that engineering improvements have kept level down to index shown in Fig. 5.

COST SITUATION IN BRIEF

BRIEFLY, the matter of cost of generating electricity stands as follows:

1. System investment costs have gone up some 57 percent.

2. Plant operating costs have gone up some 51 percent.

3. Higher costs are likely to continue for some time. Reserve capacity to cover outages or unavailability of equipment is at an all-time low.

If the present trend of higher costs parallels similar trends after the Civil War and World War I, the top will apparently be around 85 percent over 1940 costs, with a final leveling off possibly at a 60 percent advance. This estimate is based on a continuance of labor efficiency at its present level. Progressive engineering is paying its way by reducing plant first cost in each of its elements, at the same time keeping operating costs down by improving fuel economy, operating conditions and maintenance.

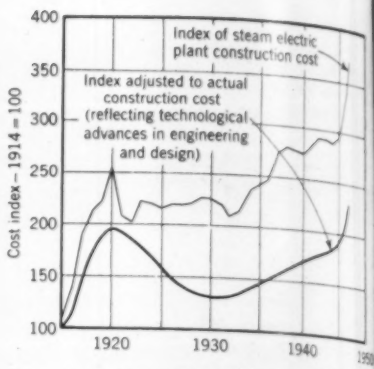


FIG. 5. AVERAGE COST per kilowatt of steam-electric plants built by Stone & Webster during last 45 years on which cost records are available is converted to index with 1914 costs taken as 100.[5] Among engineering advances which have kept powerplant cost index down are: (1) Larger boiler and turbine units which require less building than for many small units; (2) high rates of boiler heat transfer with decreased boiler size, permitting generation of much more steam per square foot of heating surface, and (3) high-pressure, high-temperature plant cycles that require much less steam and hence less space for given output.

costs as a means of progressing to lower costs. Rather than hope for cost reductions, let the objective be improved designs and construction methods that will reduce costs despite present handicaps.

An important factor in keeping first cost down is the mounting use of existing plant, usually expressed as higher load factor. Figure 8 shows an amazing 23-percent rise between 1940 and 1946, which proportionately increased the financial return not only from the equipment but also from the operating organization, which usually requires no more man-hours to handle the greater output. The same operator is required whether equipment runs at half load or full load.

Controllable Costs. (Many of these affect operating costs as well as first costs.)

1. Higher availability
2. Higher load factor
3. Single boiler-turbine units
4. Large-size units
5. Turbines
6. Circulating water systems
7. Condensers
8. Piping and valves
9. Building

A proper design policy should assure that the new capacity is a direct function of over-all economics only, and *not* a haphazard agglomeration of the thousand and one ideas that may be expressed by plant superintendents, mechanical engineers, electrical engineers, structural engineers, and architects. It should be definitely understood which particular individual is to be responsible for combing out non-essentials, economically unsound ideas, and pet schemes.

Choice of an outdoor type of plant is one means of decreasing building costs, particularly in smaller plants having units of around 20,000 kw or less, where the saving is appreciable because the building cost is a larger proportion of the total cost. The saving is proportionately less in the case of 100,000-kw units, as building cubage per kilowatt is so much less. This subject has been ably discussed at various meetings of the American Society of Mechanical Engineers.

Other Cost Factors Must Be Considered

The saving in building cost must, of course, be balanced against increased operating costs and possible delays in inspections and overhauls that may occur in inclement weather. The usual peak of overhauls on the American Gas and Electric Central System is during the months of December through May, and comparatively little is scheduled from June to December. Additional reserve capacity would be needed for the extra time required by overhauls during inclement weather, or else capacity would have to be purchased from other utilities.

At a number of plants in this system the heaviest pieces were skidded into position and a crane was provided only for the heaviest pieces handled during normal maintenance. At the Logan, Atlantic City and other plants, the turbine-room crane is large enough to handle only the usual pieces during normal overhauls and cannot handle the generator stator.

The amount of cement is being reduced by more careful control of concrete mixing on the job. Instead of carrying foundations 4 ft below the frost line, highway-type slab construction is reducing the cost of light foundations. Use of glass block and solid masonry walls instead of steel

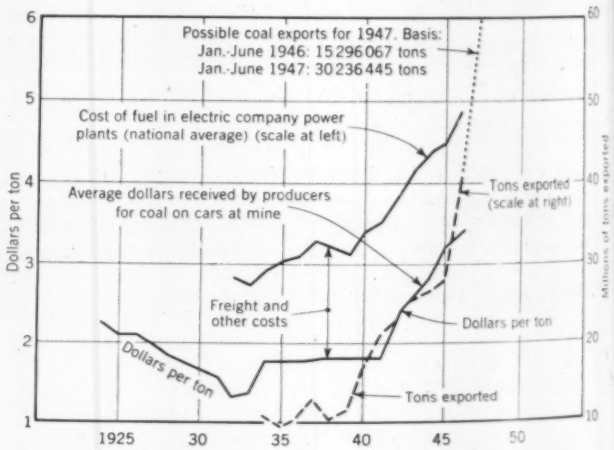


FIG. 6. FUEL COST at mine has increased from $1.81 in 1939 to $3.45 in 1946. Note how price has increased as exports increased. Source of data is U.S. Bureau of Mines and Edison Electric Institute.

ash will reduce future maintenance costs. Equipment is arranged to minimize building dimensions, yet with an eye to minimizing the cost of future operation and maintenance for which adequate space is needed.

For years brick substations were taken for granted. An analysis of present-day costs of 20×30-ft substation buildings without foundations shows the following comparative costs:

Steel with insulated walls and roof	$ 2,300
Transite sheeting and insulation	4,700
8-in. brick construction	8,000
12-in. brick construction	10,000

Needless to say, steel substations are now used wherever possible.

Former standard practice dictated latticed columns and girders for substation structures, but this design for a 22-kv substation would cost $4,400 against $2,700 if rolled members were used. Copper tubing and connectors for such a substation would cost $1,700; using aluminum the cost would be $1,200.

More than ever a construction job requires adequate scheduling and expediting of equipment so that it will arrive when needed. Timely delivery of materials involves placing orders early and avoiding changes in plans like the plague.

Reducing Operating Costs

Component factors of operating costs are fuel, operating labor and maintenance. Taxes, insurance and several other items also enter into operating costs but are not subject to much control.

Fuel. Obviously, it is most desirable to minimize the amount of fuel burned but of course this should only be done within the limits of over-all financial economy, to attain the bottom-of-the-curve costs including first cost, fuel cost, operating labor and maintenance. For example, boiler efficiency may be increased by installing large air heaters that will reduce outgoing flue-gas temperatures, but there is a point at which the law of diminishing returns reduces earnings to the vanishing point. Because investment costs and maintenance are higher, it is not necessarily true that higher efficiency equipment gives optimum financial economy. Low exit flue-gas temperature also increases the amount of corrosion and hence the maintenance of the air heater, particularly with high-sulfur coals.

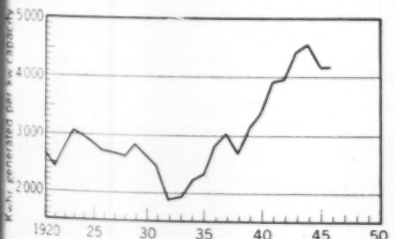


FIG. 8. ABOUT TWICE kilowatt-hour output of 1934 is now being obtained per kilowatt of installed capacity in steam-electric plants. Load factors of systems are higher and there is less reserve capacity.

Figure 9 indicates an industry-wide reduction in the use of fuel of almost 5 percent since 1940. Fuel use per kilowatt is now only 47.5 percent of that in 1921. Putting it another way, for the same amount of coal, 2.1 times more power is obtained. This economy is attained not merely by more efficient plant cycles, but also by the integration and the interconnection of large systems to make a few large economical plants possible instead of many uneconomic small ones.

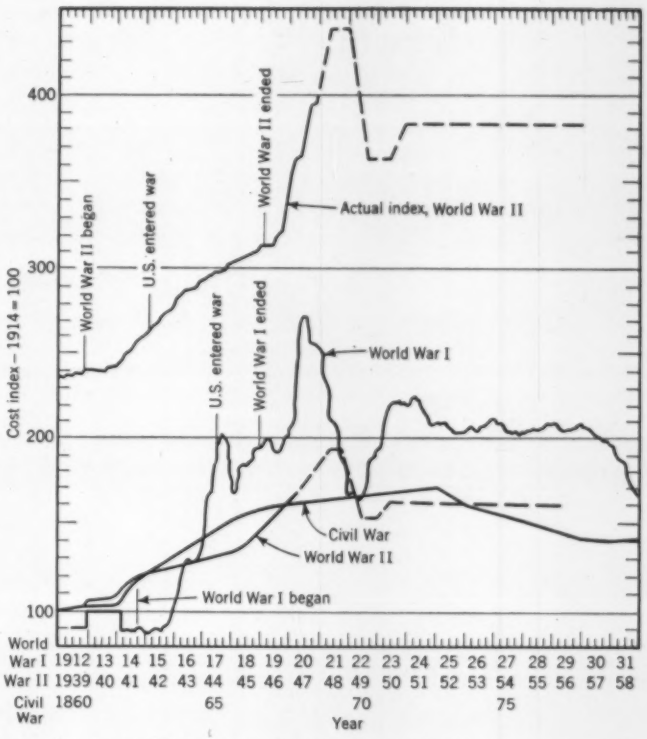

Cost index – 1914 = 100
400
300
200
100
World War II ended
Actual index, World War II
World War II began
U.S. entered war
U.S. entered war
World War I ended
World War I
Civil War
World War II
World War I began
World War I 1912 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
War II 1939 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58
Civil War 1860 65 70 75
Year

FIG. 7. CURVES SHOW construction cost trends as aftermath of Civil War and World Wars. For five years following end of war, following prices are percentage of those at start of war:

	%	Source
Civil War	160	ASCE PROCEEDINGS, Apr.'46[10]
World War I	208	*Eng. News-Record*[5]
World War II	160(?)	*Eng. News-Record*[5]

The three lower curves are plotted to the same index of 100 at the start of the war. The upper curve starts at the actual index 238 that existed in 1940, using 1913 as the base year.

Operating Labor. Too often a plant is designed with little thought to the organization that will operate it. Before the design has "jelled," the operating organization should be set up and the plant so designed and fitted with control equipment and instruments that this organization can function properly. In setting up the operating organization in one plant, the thought should be not to create a facsimile of the organization in some other plant but rather to build upon the experience of the past to develop a well-knit and intelligent organization. Remote control of auxiliaries from a central point, with the instruments that show what is happening, may be likened to the control of a large modern airplane. The pilot cannot possibly see all of the plane elements that he is controlling; he must depend on the instruments to check the proper functioning of all the parts.

Maintenance. Maintenance costs are lowered by using larger-sized units, by selecting and purchasing equipment on a long-range basis rather than on a first-cost basis, by providing proper repair facilities and by a keen appreciation of availability. Poor availability increases maintenance costs because equipment that is out of service must be repaired, entailing the expenditure of both material and labor dollars.

Plant Availability. Just as there is a close relationship between investment cost and availability, so there is between operating costs and availability. When a new, efficient

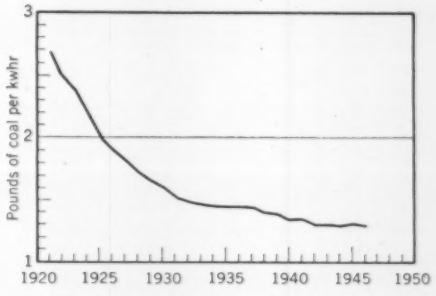
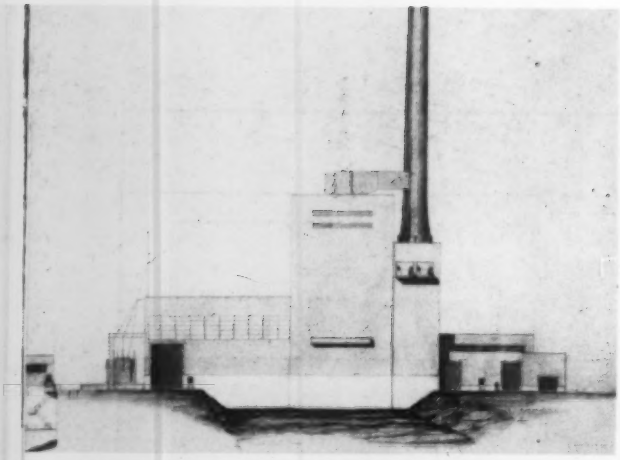


FIG. 9. FUEL COSTS per kilowatt-hour are decreasing as less coal is used. For same amount of coal, 2.1 times more power is being obtained now than in 1921. Source of data is Edison Electric Institute.



ECONOMIES IN CONSTRUCTION through careful attention to design details include more careful review of floor live loads in planning 300,000-kw Philip Sporn Plant. Exterior walls will be terra cotta hollow tile backed with buff face-brick on inside. Interior partitions will be 4-in. cinder block.

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[7] "The 2,000 Psi, 1050 F and 1000 F Reheat Cycle at the Philip Sporn and Twin Branch Steam-Electric Stations" Philip Sporn, ASME meeting, December 3, 1947. See bibliography.

[8] "New Generating Capacity Installations," Edison Electric Institute Bulletin October 1947, p. 369.

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plant is out of service, either old generating equipment must be operated (resulting in higher fuel, labor and maintenance costs, which may be higher than the average revenue per kilowatt-hour) or else capacity and energy must be purchased from some contiguous utility through interconnection and this, of course, costs more.

Epilogue

If prices could be *talked* down, normalcy would have been restored long since. But what substitute is there for the distinctively American technique to increase production of desired products and thereby reduce prices? Production, not controls, appears to be the key to prices.

Construction costs and operating costs of steam-electric generating systems are up. It looks as though these higher costs will be with us for some years, judging from past experience with prices after wars, the nature of the factors contributing to the rise, and the need of installing facilities regardless of cost. The economic picture would be dim if it were not possible to mitigate those effects by a progressive and open-minded engineering attitude that attempts to subordinate individual likes and dislikes to getting the best over-all combination of investment and operating costs.

Acknowledgments

This paper would not be complete without an expression of appreciation of the assistance given by Messrs. Philip Sporn, M.ASCE, W. G. Mervine, H. A. Kammer, Assoc. M. ASCE, and V. M. Mulford, of American Gas and Electric Service Corp.

Economies in Cost of Structures Minimize Steam Generated Energy Output Costs

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THE RECENT RAPID INCREASE in costs of material, labor and equipment going into steam plants presents a serious problem to utility managements and engineers. As Mr. Krieg states, no effort should be spared to reduce investment in utility plants and production costs of energy—consistent with ability to give dependable service to the public.

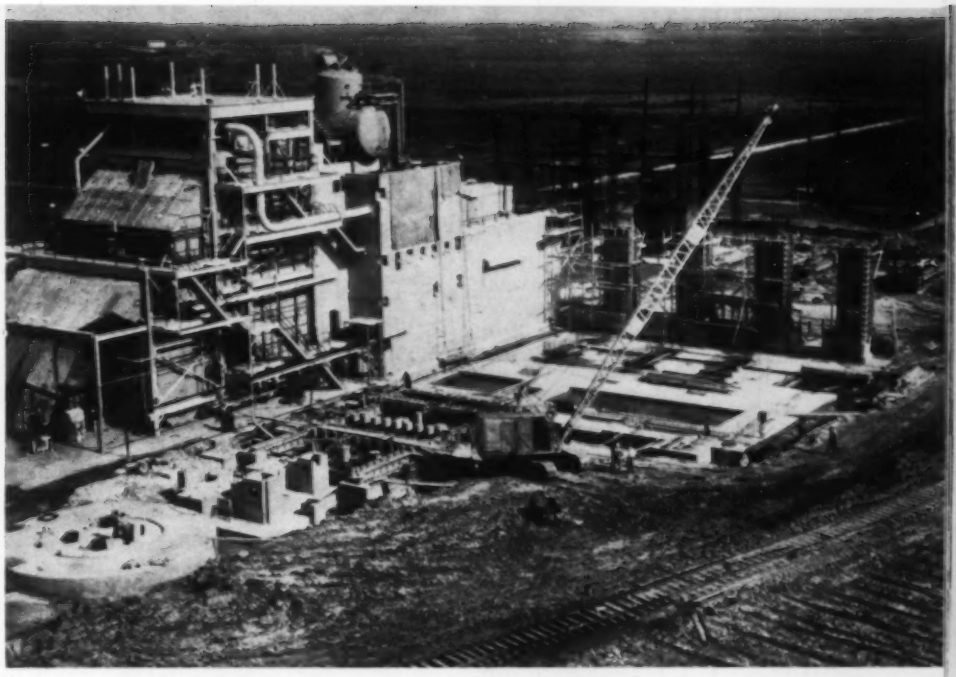
Mr. Krieg's paper brings out and develops a number of methods by which economies can be effected, both in first cost and in production expense. Of notable assistance in making such savings has been the advance in size, efficiency and reliability of turbine-generators and steam generators. However, as is emphasized in the paper, economies effected have not been sufficient to compensate for the rapidly increasing investment costs of power stations, and of fuel and labor for their operation. It is probable that in many instances rate advances will be called for to enable the utilities to secure additional capital, on reasonable terms, for enlargement of facilities to meet the growing demands for electric service.

Plant Design Involves Many Elements

In designing a steam plant, engineering experience and judgment must be utilized to strike an economic balance between important elements including reliability in operation, fuel efficiency as affected by steam conditions and by the heat-balance arrangement selected, magnitude of operating and maintenance labor as influenced by plant layout, and investment costs with resultant fixed charges. This general problem meets the engineer at every turn, and upon its successful solution depends in large measure the obtaining of minimum total costs for energy output. A review of these elements would far exceed the scope of a brief discussion.

In the plant designs on which Mr. Krieg has been active, it has in general been the policy to provide complete housing for steam and electric apparatus. It has doubtless been considered that the dollar saving estimated as obtainable by reduction of structures is insufficient compensation for whatever operating disadvantages are anticipated.

Steam plants with the design and construction of which the writer has been connected, built during the past decade and more for clients in all parts of the country, have to an increasing extent been taking advant-



ENGINEERING EXPERIENCE AND JUDGMENT are needed to strike economic balance between important elements involved in designing steam generating plant. View of West Junction gas-fired steam-electric station of Houston Lighting & Power Co. shows temporary end of original 35,000-kw steam plant with sectional steel turbine housing on roof, auxiliary bay in middle with de-aerating heater on top, and steam generator at left. Construction under way for 35,000-kw extension includes (left to right) chimney foundation, footings for steam-generating equipment and slab on which turbine pedestal will be placed.

age of economies in cost of structures made possible by the adoption of semi-outdoor or outdoor installation of equipment. These stations on the average have been smaller in size than those with which Mr. Krieg has worked, usually ranging from 30,000 to 130,000 kw in capability. A large number of them have been located in the South and Southwest, burning gas and oil fuel, but others have been built in the North, subject to the usual winter conditions, and laid out for the use of pulverized coal.

Including those of all degrees of outdoor design, there have been roughly 100 plant-years of operation of such stations engineered by Ebasco Services Incorporated, with an aggregate capacity of 500,000 kw. Additional plants of that type under design and construction aggregate something over 1,500,000 kw.

Reduction of Structures

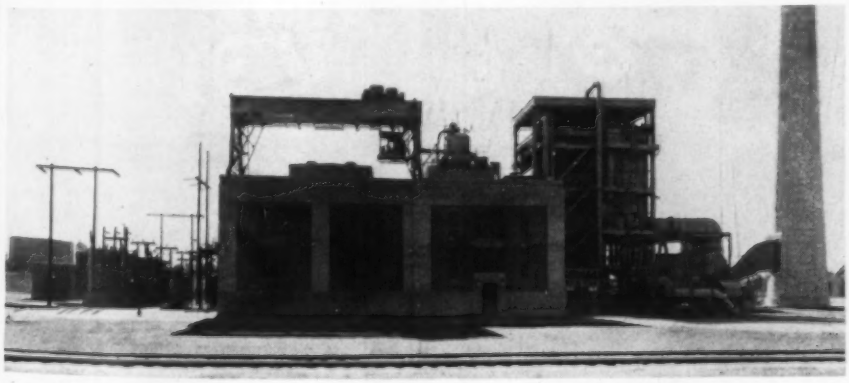
There are several types of plant of the semi-outdoor or outdoor type. The first step is naturally to place the steam generators outdoors, protecting only the firing aisle, and in the case of pulverized-coal plants, the bunkers and coal-preparation equipment. This design has recently been adopted for a number of prominent new installations in the Northeast, some of large size.

What may be considered a second step in economy of structures is the elimination of full turbine room, placing the turbine-generator on an open deck, protected by a light removable housing or by a low structure incorporating roof hatches. The station crane is an outdoor gantry instead of the indoor crane used in fully housed turbine installations.

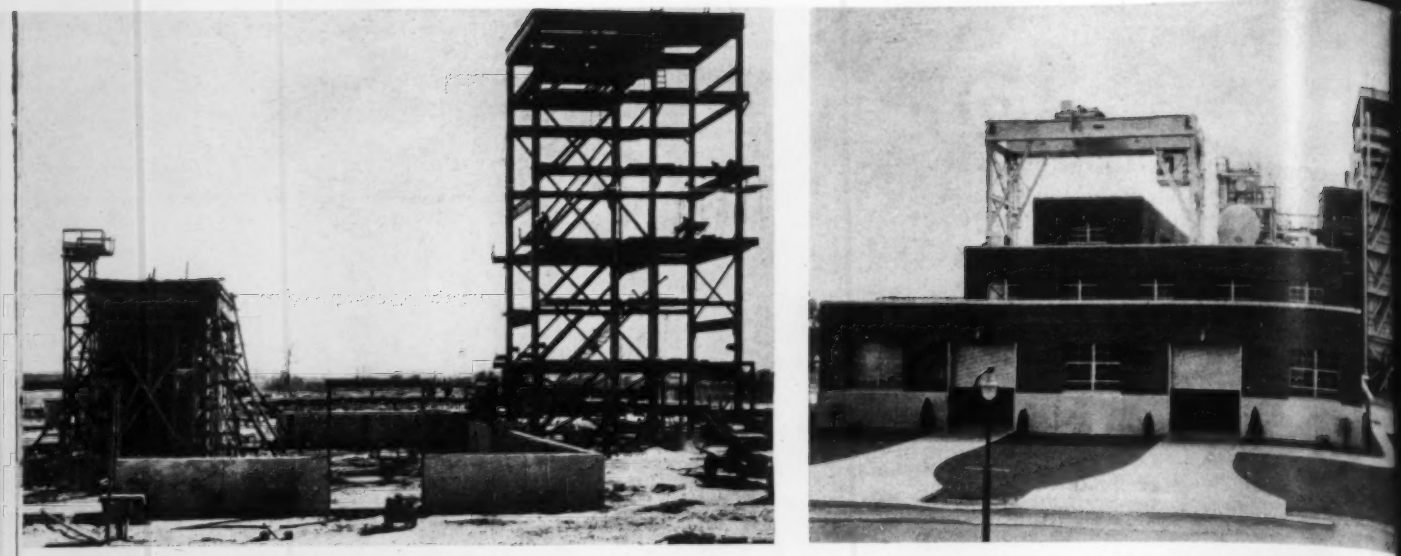
A still further saving is accomplished by taking additional steps in reduction of structures, eliminating all or a part of the housing over the turbine-generator and leaving condenser space open under the turbine, omitting weather protection from much of the auxiliary equipment, and confining the protective housing largely to the control room and to some of the more delicate apparatus. There are of course many intermediate stages in this design trend, but the three types noted may be classified roughly as: (1) with outdoor boiler, (2) semi-outdoor, and (3) outdoor.

The initial step, with outdoor boiler, effects an economy in structures of the magnitude of $3 per kw of plant capability. For example, recent installations designed for two 40,000-kw turbine units served by two pulverized-coal-fired steam generators, will show a saving estimated at $200,000 or more. In this design, boiler operators are protected in performing most operating functions, and much maintenance can be done without exposure to the weather. Full protection is afforded at the firing end of the boiler, for raw-coal bunkers and coal-preparation equipment, and sometimes for a zone around the boiler at the elevation of the main drum.

Experience with the second type, the semi-outdoor, indicates an additional saving similar to that accomplished by the first, the total being of the magnitude of $6 per kw of plant capability. In this design, the operating crew is still protected from the weather in performing all routine functions, and in doing minor maintenance work; for instance, there is considerable space provided around the turbine unit, inside the relatively small housing. Major overhaul, involving dismantling of the turbine unit, requires removal of a part or the whole of the light protective structure, or removal of one or more roof hatches, giving access for handling by the overhead gantry crane. In doing such major work in inclement weather, it may be necessary to employ tarpaulins or other temporary protection. In this type of structure, the condenser enclosure is usually fully housed. Full protection is



SEMI-OUTDOOR INSTALLATIONS providing economies in cost of structures are common in South and Southwest. Pictured here is Harvey Couch 30,000-kw gas-fired steam-electric station of Arkansas Power & Light Co. View shows permanent or entrance end of building, with gantry crane above sectional steel housing for turbine-generator. At right is steam-generating equipment.



EASE OF CONSTRUCTION characterizes simple type of plant springing from ground level. View of Cecil Lynch 30,000-kw gas-fired steam-electric station of Arkansas Power & Light Co. shows early construction (above, left) with form work for turbine pedestal on base at left, and steam-generator structural steel at right. View of completed plant (above, right) shows gantry crane over small brick-walled turbine-generator housing, and steam-generating equipment at right.

given the feed pumps, some heaters and other auxiliaries as well as the control room, but the de-aerating heater is frequently placed on the roof. In this design, as well as in the first, draft fans are normally outdoors, and not infrequently circulators and other rugged equipment.

The third step, resulting in a "stripped" plant, may save $10 or more per kw. A design now under way for a two-unit 120,000-kw gas-fired steam station is calculated to save well over $1,000,000 in investment cost, as compared with a conventional fully housed plant.

Transformers and circuit-breaker installations have of course been outdoors for over 30 years, and this is the general practice for high-voltage electrical equipment. The lower-voltage apparatus also, such as station-service transformers and breakers, is now frequently placed outdoors. This design usually means a saving in first cost.

It should be emphasized that the approximate savings per kilowatt of plant capacity—$3, $6 and $10, cited as obtainable by the three types of design as compared with a fully housed station—are very approximate figures and that the actual saving in any one case may be less or more, per unit of station capability. In order to make an accurate comparison, it is necessary to lay out and estimate a complete plant, on the fully housed and outdoor bases.

Outdoor Stations Have Many Advantages

An engineering opinion sometimes held is that an outdoor installation is justified only by the saving in investment. The writer feels that this is not a full statement of the case. Testimony from some plant operators, particularly in the southern part of the United States, is to the effect that operating personnel prefer the relatively compact semi-outdoor station to the old fully housed type, as being more comfortable in the summertime and reasonably comfortable during other seasons. There is also a reduction in maintenance of structures, and because of the relative compactness of a station of the outdoor or semi-outdoor type, the labor of operation may be easier.

The outdoor type lends itself to simplicity of design, and, particularly with cooling-tower plants, to the placing of the lower floor at or near the ground level, avoiding excavation. Construction work is much simplified, as the turbine pedestal, boiler steel, and other structures and equipment may be installed before any building enclosure is erected.

Although as has been stated there are certain collateral advantages in this simplified type of construction, the major reason for it is that investment dollars are saved—in most instances with no serious disadvantage in operation and maintenance. It is, as Mr. Krieg brings out, impossible to counterbalance the pronounced upward trend in cost of material, labor and equipment, by simplification of plant, but all legitimate means for saving should be taken advantage of, particularly in view of increasing government and other competition with the utility industry.

Plant Design Presents Opportunity to Control Mounting Steam Power Generation Costs

WILLIAM F. RYAN

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CONSTRUCTION COST may well be the most serious factor in the mounting costs of steam power generation. It is also a factor which powerplant designers can do something to combat. The American Gas and Electric curve shown in Fig. 1 (page 14) reflects actual over-all experience and is not an index based merely on relative prices and wages. The "index" is obviously a straight line drawn from prewar to postwar averages. Data from other sources show a quite different characteristic, leveling out during the war and rising very steeply since V-J Day. Ebasco data for the complete period are reported by J. P. Anderson in the Edison Electric Institute Bulletin for December 1947.

The Stone & Webster index for electric plant shown in Fig. 4 agrees very closely with the Handy Index shown in Fig. 1, while the Stone & Webster adjusted index for steam generating stations, shown in Fig. 5, as in remarkably close agreement with the Ebasco experience, at least prior to 1947. Both the A.G. and E. and Ebasco trends show a much higher index in 1947 than the Stone & Webster figures. The latter are for

plants which were substantially completed in that year and whose ultimate costs were predictable with reasonable accuracy. The other data may include plants in a less advanced stage of construction, in which case the indices are based partly on estimates of future costs. Possibly these differences could be resolved by a careful inquiry into the bases of the several indices, but to do so would be chiefly of academic interest. Comparison of costs in 1947 with those in 1940 does not tell us where we are going or what we can do about it.

As to where we are going, Mr. Krieg has been bold enough to hazard a guess, based on what happened after previous wars. He suggests that we may level out on another postwar plateau at about 160 percent of 1940 costs, the relative elevation reached after World War I.

The expectation of future costs only 60 percent above those of 1940 presupposes a more cooperative attitude on the part of the building trades than we have any present reason to assume. They must learn that high wages for short hours can be maintained only by high production per man-hour. In spite of our progressive education, we as a nation should be able to absorb the simple concept that no amount of money can buy food that is not raised or coal that is not mined, and that there is little warmth and less nourishment in a ton of dollar bills.

Mr. Krieg makes public data on the inefficiency of construction labor which others have hesitated to disclose. With this precedent others may be encouraged to lay bare the whole miserable story, in specific facts and not in complaining generalities. Pitiless publicity has corrected many evils, and it may help in this case too.

What Can Designing Engineers Do?

There is much that the building trades and the politicians might do to retard the soaring costs of steam power plants, but they can hardly be expected to do it. As to what the designing engineer can do, Mr. Krieg has made many specific suggestions in a previous paper on "Economies in Power Plant Design" (Reference No. 2 of bibliography, page 18). Many of the opportunities to lower steam-plant costs by simplification and curtailment involve some loss of operating convenience and some loss of flexibility, but they are so important from the cost viewpoint that they must be carefully considered.

One much discussed method of reducing costs is to pattern steam plant designs on oil refineries and other process industries, and install the equipment out of doors. Most so-called out-of-door plants, however, have a great deal of housing. A wall is left out here and a roof there, but then a canopy is erected over this and a doghouse over that, with the result that we never know precisely whether we are inside or out. An out-of-door steam plant can be built, however. What is more, it can be operated. An accompanying illustration shows such a plant, built by Stone & Webster in Texas in 1943, which has operated with an availability factor of over 90 percent ever since. This "outdoor" plant is out of doors! Neither the boilers nor the auxiliaries are housed in any way. There is not even a hood over the gage glass or instrument panel, or a shack in which the operator can take refuge from the tropical rains.

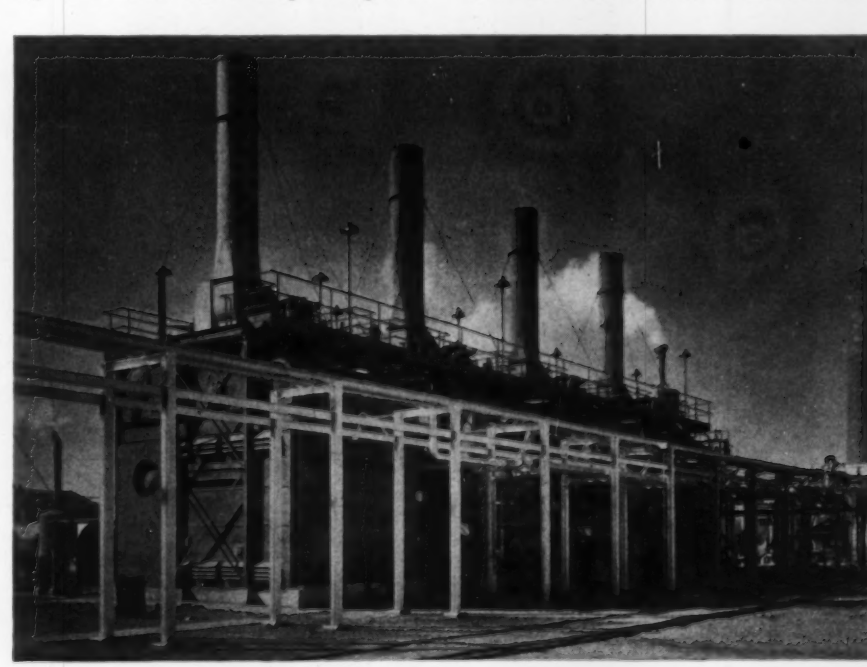
Effect of Weather on Design

This design is carrying out-of-door construction to its logical extreme, and undoubtedly saves something in cost of construction, but it can hardly be recommended for a major steam-electric generating plant in the Northeast or Middle West because of the climate. Mr. Krieg calls attention to a very important factor in considering the extent to which power generating equipment should be housed, when he mentions the effect a bad break in the weather may have on scheduled outage. It would be poor economy to save the expense of a couple of walls and a roof if it is necessary to install several thousand additional kilowatts as a reserve against the unexpected and protracted outage of an unhoused unit.

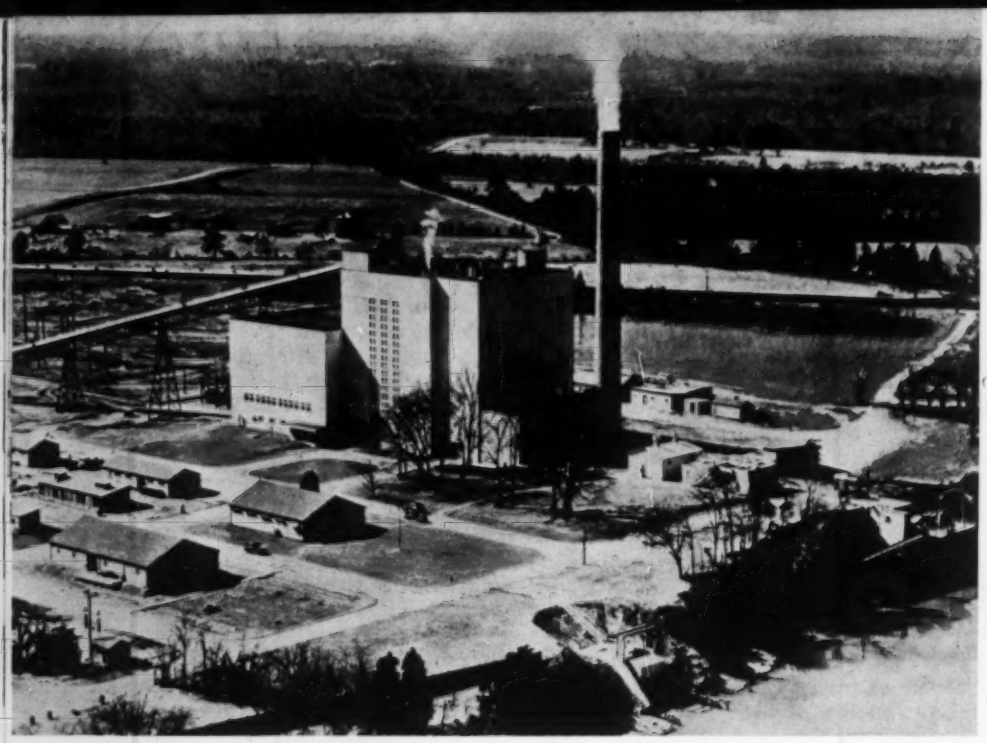
Where housing is provided, a careful study of building materials will permit savings in plant costs. Public utilities generally have exercised a due regard for the appearance of their communities and have paid considerable attention to the architecture of their central stations. However, it is not necessary to use masonry construction to produce a decent-looking power plant. An accompanying illustration showing the Chesterfield Station of the Virginia Electric and Power Co. demonstrates the point.

Cost Index Is Sound Barometer

Expressing cost trends by the index method, as Mr. Krieg has done, is far superior to translating them into "costs per kilowatt." No unit used in the power industry is more meaningless. Steam power installations have been made for less than $60 per kilowatt, and others, equally well designed and efficiently constructed, have cost more than $250 per kilowatt. To compare the "cost per kilowatt" of one job with another, it is necessary to know the size of the installation, whether it is a new installation or an extension, when it was built, where, for what kind of fuel, how the fuel is delivered and how



OUTDOOR STEAM POWER plant built in Texas in 1943 is operated with availability factor of 90 percent. Although large saving in construction cost is realized, design is not recommended for more severe Northeast or Middle West climates.



GOOD APPEARANCE of power plant is not dependent upon use of masonry. Chesterfield Station of Virginia Electric and Power Co., built during war, has corrugated asbestos walls, erected on wood girts. Temporary walls have proved so satisfactory from every point of view, including appearance, that they will not be replaced with masonry as originally planned. Extension of station now under construction is of similar design except for steel girts instead of wood.

much storage is required. It is also necessary to know local climatic conditions, fuel costs and water supply, and for what type of electrical service the station is designed.

In addition to these physical variables there is the question of what is included in the cost. Does it include land, legal expense, engineering and interest during construction? And finally it is necessary to know what kind of a kilowatt "the cost is per." Is it name-plate rating, and if so at what power factor? Or is it a kilowatt of maximum capability? If the latter, is the maximum capability based on the manufacturer's guarantees, the design engineer's hopes, the load dispatcher's expectations or the operating engineer's fears? When all these questions have been answered, cost per kilowatt acquires some meaning, but not too much. The unit of "cost per kilowatt" is as meaningless for hydro plants as it is for steam.

The cost index, however, shows that for particular location and service conditions, regardless of the accounting system and method of counting kilowatts used, costs have advanced or receded in some definite relation.

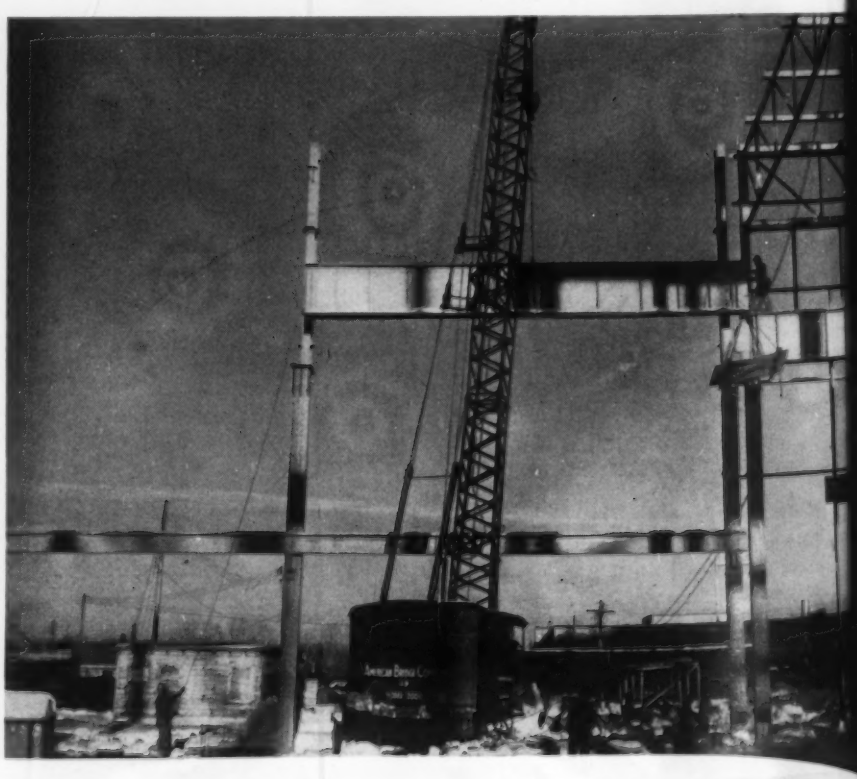
New 20-Acre Plant Cuts Turbine-Generator Production Time

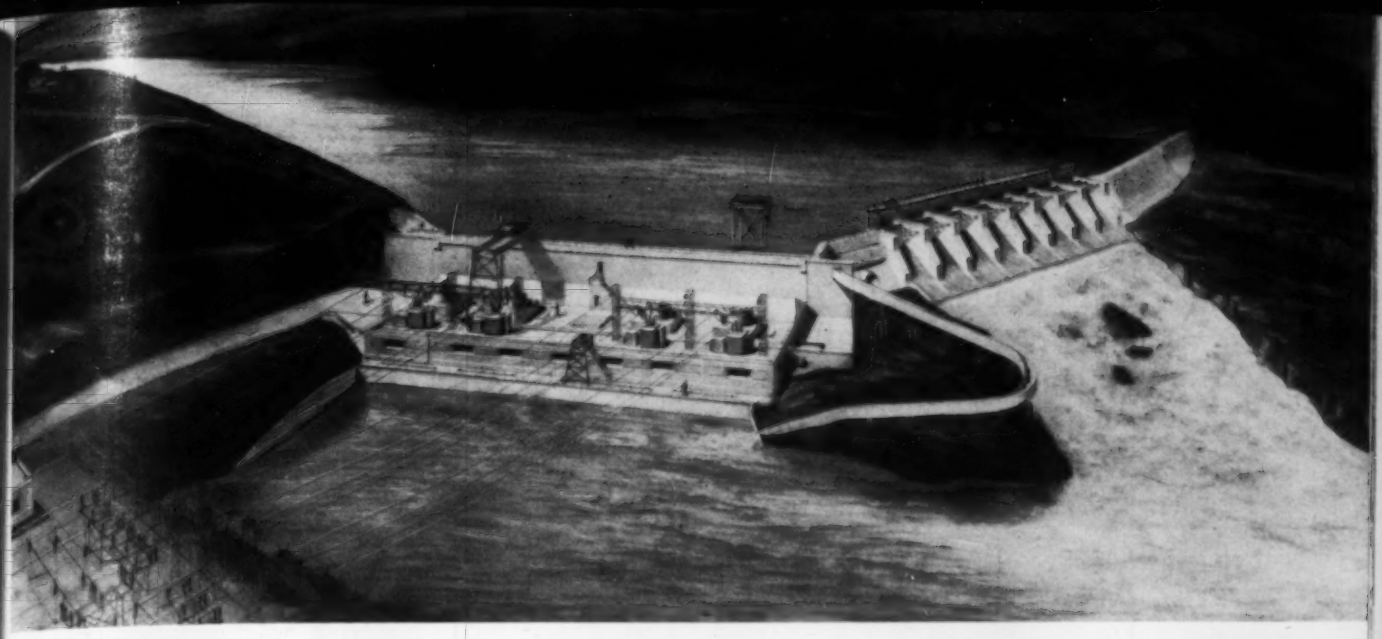
INCREASED USE of electric power in the United States, to a total consumption 100 percent more than that of a decade ago, points up the need for expanded power generation facilities. The demand for electricity is so great that many obsolete turbines which ordinarily would be retired or kept in reserve are in regular operation.

An indication of how the expanded needs for power generation are being met is the General Electric Company's $300,000,000 over-all expansion plan aimed at manufacturing in the next four years steam turbine generators capable of producing more than 9,500,000 kw. In a recent announcement, the General Electric Co. stated that it expects to increase its present production level for the next eight to ten years and predicted that it will be five years before production of steam turbines equals the demand for them. When that point is reached continuing growth and obsolescence will require still more turbine production at a high rate.

Now under construction as part of General Electric Company's overall expansion plan—and scheduled for completion in about 16 months—is a new $20,000,000 turbine building at its Schenectady Works. The building (see front cover and accompanying illustration), which will cover 20 acres and have a million square feet of floor space, will have 50 traveling cranes ranging in capacity up to 200 tons. Steel piling 80 to 140 ft long will carry the tremendous weight involved in turbine manufacture.

STEEL GIRDERS ARE ERECTED for crane-way in General Electric Company's new Schenectady Works. Million square feet of floor space will house company's entire turbine production facilities.





OUTDOOR-TYPE STATION reduces investment and speeds construction. Plant requires less structural work and permits advantageous use of outdoor crane for equipment installation. Artist's sketch shows Lower Salmon Hydroelectric Development, 60,000-kw station of Idaho Power Co., now under construction on Snake River in Idaho. Plant superstructure is pared to practicable limit and four generators are placed on deck above turbine operating floor. Plant is one of seven outdoor-type stations that have proved satisfactory to Idaho Power Co. in 70 plant-operating-years of experience.

Economies in

Design, Construction and Operation Control Rising Costs of Hydro Power

M. G. SALZMAN, M. ASCE
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STATISTICS SHOW that hydroelectric generating costs have risen considerably during the last ten years along with labor wage rates and material costs. Despite these increases, economies in design, construction and operation have been effective in maintaining the cost of hydro power and energy production on a relative basis with the general increase in the cost of living as reflected by the purchasing value of the dollar. Engineering efforts have been expended toward a reduction in unit investment costs by installation of larger-capacity units, improvements in design and simplification of powerhouse structures with reduced space requirements for auxiliary and electrical equipment. Increased operating efficiency and improved maintenance methods have tended to moderate the effects of higher costs for operating labor and materials. The effect of this cost trend, as compared with the increased cost of producing power and energy by other means, has been to stimulate the development of hydroelectric projects that can be effectively utilized in the load curve of a large system. This article is based on a paper presented by Mr. Salzman before the Power Division at the ASCE Annual Meeting in New York. Discussions follow.

WHAT HAS HAPPENED to hydroelectric power generating costs and what are the future prospects for the development of hydro plants? These are two important questions which utility engineers are asking today. Even in these unsettled times it is well to stop and consider seriously the import of the rising price trend on the various phases of hydroelectric power and energy generation.

Not long ago many engineers believed that the days of economical hydro development were numbered. Steam-plant design and efficiencies had developed to an appreciable extent and were capable of further improvement, whereas hydro-plant efficiencies had practically reached the optimum. Most of the attractive sites near load centers had already been developed. High transmission costs imposed a severe liability on hydro plants located a considerable distance from the load centers and restricted their development since, in most cases, fuel could be transported more cheaply than electrical energy. The outlook for hydroelectric plant construction looked very dark and long-term planning, with successive and extensive river developments by utility companies, was discarded in favor of intensive steam-plant development.

ACCOMPLISHMENTS of the last decade indicate that engineers designing hydro plants have done much to offset the many and diverse factors tending to increase the cost of energy generation. The future appears somewhat brighter for the development of attractive sites which are adaptable to integrated system operation.

Plans of private companies for future hydro developments received a further setback in the interpretation of water-power enactments and the stringent licensing requirements set up by government regulatory bodies. During the decade from 1930 to 1940, hydro development in this country was virtually at a standstill except for government-sponsored power projects built in conjunction with other purposes such as irrigation, navigation and flood control. In spite of this artificial stimulation of hydro development, the increasing power requirements of most areas were taken

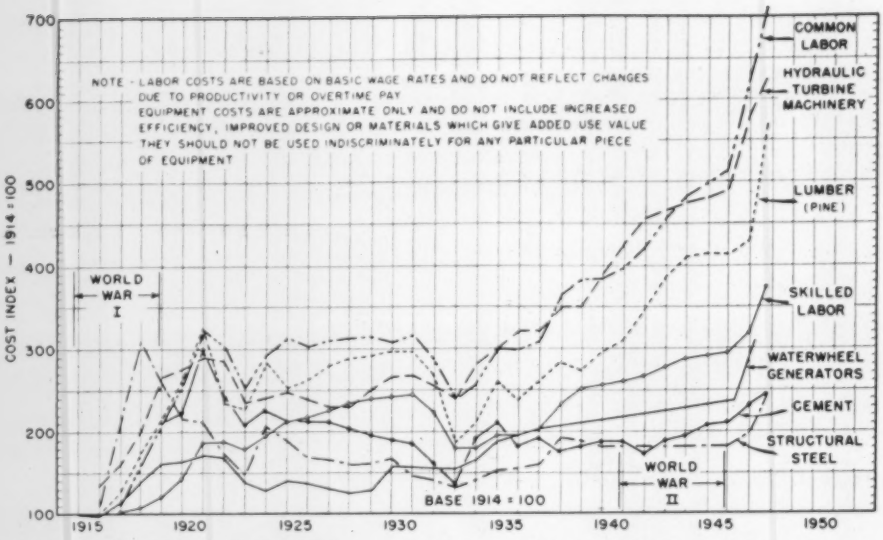


FIG. 1. CURVES SHOW TRENDS of principal items affecting hydroelectric plant construction cost. Labor component, major item in hydro construction costs, has risen sharply in past ten years. Lumber and hydraulic turbine prices are now about double those of 1936.

care of by new steam-plant additions, which had the effect of utilizing existing hydro plants for peak-load generation and low-load-factor operation or for base-load operation when there was adequate natural stream flow. It was found that these plants could be effectively adapted to the requirements of an interconnected system and were very advantageous because they could be speedily put into operation when needed.

Hydro plants with storage facilities were flexible for meeting variable-load requirements, and secondary energy generated during times of surplus water could be used advantageously to replace fuel generation. The adaptability of these storage plants for regulating tie-line loads has also made them valuable adjuncts to other generating sources. Run-of-river plants could be utilized in the base of the load to supplant more costly steam generation. Gradually there came a realization that in most power systems a favorable balance of steam and hydro plant capacity, with coordinated operation of all power-producing facilities, resulted in a combination which reduced the over-all cost of energy.

The "competitive" attitude of hydro plants versus steam plants is no longer the vogue, and hydroelectric power is now considered as complementary to steam and other available sources of power and energy. Comparative costs are still reviewed in order to determine the economic justification for new-capacity additions, but the over-all needs of the system for base-load generation or peak capacity are considered to be the governing factor. In recent years, with the difficulties surrounding equipment deliveries, even this rational approach has been subjugated to the dire necessity of obtaining the most readily available sources of plant capacity to keep pace with the rapid and abnormal load growth on most systems.

Factors Affecting Cost of Generation

The cost of generating power is affected primarily by the capital investment or cost of constructing the project. Not only must this investment cost be expended initially regardless of prevailing labor and material costs, but it also continues year after year during the life of the plant in the form of fixed charges on the investment. In addition to the direct cost of material and labor, the investment cost normally includes expenditures for overhead and miscellaneous items, including engineering, purchasing and expediting, supervision of construction, client's engineering and administration, injuries and damages, legal services, taxes and interest during construction, as well as cost of land and land rights.

The other component cost element in a hydro plant is that of maintaining production after the plant is constructed. This requires the expenditure of many man-hours of operating and maintenance labor to effectively utilize the basic fuel or source of energy and to properly preserve the plant and equipment. In the case of hydro plants, water is the "fuel," and the efficient control of it and of the facilities used in its conveyance and transformation into useful energy is the primary objective of the operators.

SUBSTANTIAL INCREASES in the cost of operating labor and fuel for thermal plants favor the development of hydro stations. High transmission costs still impose a severe liability where plants are located remote from the load, but the extension of service areas with regional pooled operation of plants and interconnection of transmission systems makes possible the use of considerable hydro power and energy in the system load.

Each of these two basic components of cost contains items that are to some degree controllable by management, engineers' and operators' decisions in regard to planning, design, construction methods and operating techniques. Location of plant, size of installation, number and type of units, plant layout, selection and suitability of equipment are the principal controllable items of investment cost confronting engineers and designers. A large part of the investment cost of a project is determined in the conference room and on the drafting board before a spadeful of dirt is turned over. At this stage prudent planning and sound engineering design are of paramount importance in controlling costs.

With present-day mechanized construction operations, the selection and layout of the construction plant has a considerable bearing not only on the direct construction costs, but also on the over-all investment cost by virtue of the construction plant's effect on the time required to complete the project.

Efficiency of operation and adaptability of the hydro plant to system requirements are important items which can be controlled by the skill of plant and system operators.

The principal uncontrollable items affecting both investment and production costs are labor and material prices. There is no recourse but to accept the prevailing prices, since plants must be built and operated when needed, but meticulous care in the selection and use of these constituents will moderate their effects. The cost of the necessary money used to construct the plant, taxes paid to local, state and federal agencies, insurance and depreciation allowances are other uncontrollable items affecting production cost. This paper deals primarily with those items that are subject to some degree of control by hydro plant designers and operators.

Trend of Construction Costs

Hydro plant construction costs have increased appreciably during the last ten years and will undoubt-

edly continue to rise further in conformity with the general trend in construction labor wage rates, equipment and material prices. These are, of course, a direct effect of the recent war and it is impossible to foretell just when the level of stabilization will be reached or whether there will be a recession in the same pattern that has followed previous wars. At present the trend of construction costs is surging sharply upward and has reached unprecedented heights. The underlying economic causes for this drastic rise in the price of materials and services have been expounded many times and need not be repeated here. It is only the factors influencing hydro plant construction that are of interest to engineers analyzing costs.

Ingredients in Cost Rise

Figure 1 depicts the trend, from 1915 to date, of the principal items entering into the construction of hydroelectric projects. Wages paid for common and skilled labor are major items. The labor component in hydro construction costs may approach as much as 40 percent of the total investment, exclusive of land costs. Consequently, trends of labor rates materially affect the over-all trend. It will be noted that since 1936, skilled labor has risen approximately 85 percent and common labor 123 percent. These increases could be amplified by the inclusion of overtime pay which has been prevalent during the war and in recent years. Other primary ingredients in hydro plant costs are the prices of materials, such as cement, lumber and steel going into the construction of dams, flow lines, tunnels, powerhouses and appurtenant structures. Since 1936, cement used in concrete structures has gone up 26 percent, lumber for forms, etc., about 100 percent, and structural steel, more than 50 percent. The effect of each of these items on the over-all cost varies with the nature of the development.

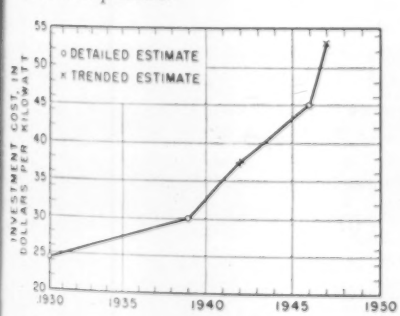
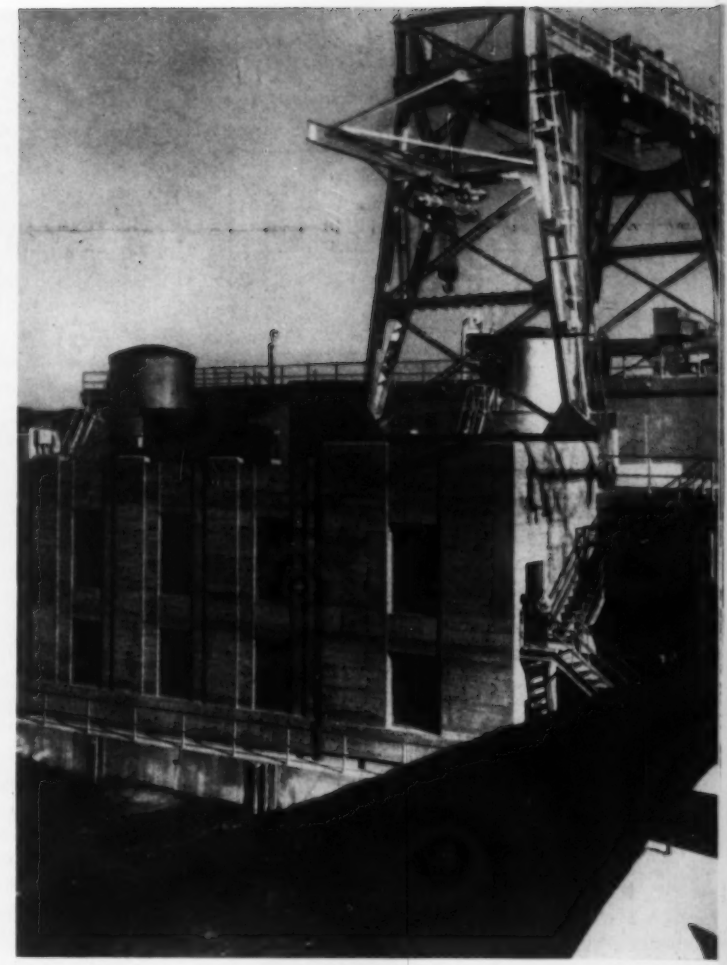


FIG. 2. TREND OF EQUIPMENT cost of hydro plant is indicated by curve based on successive estimates, made between 1930 and 1947, of 45,000-kw extension to plant.



POWERPLANT DESIGN should be functional in character since production of kilowatt-hours is primary objective. Downstream view of recently completed Upper Salmon Units 3 and 4, Plant of Idaho Power Co. on Snake River in Idaho, shows single gantry crane which serves intake gates, draft-tube unwatering and general powerhouse and substation service at considerable saving in cost.

The most startling increase, however, has been in the price of hydraulic turbines, which has practically doubled since 1936, and in that of electrical generating equipment which has gone up approximately 65 percent in the last ten years, mainly because of the greatly increased price of factory skilled labor.

Despite higher construction costs, the over-all unit investment cost may be appreciably reduced by the low cost of incremental capacity obtained by additions to existing plants where there is already a considerable investment in dam and structures.

An indication of the long-range effect of rising material and equipment costs may be noted from a series of successive estimates made for the same unit between 1930 and 1947. These estimates, prepared for the prospective addition of a 45,000-kw unit to an existing hydroelectric plant, included equipping the intake with screens, installing a short penstock extension with an air valve and butterfly valve, a hydraulic turbine with governor and auxiliaries, and a generating unit and exciter with transformers and substation equipment. The original estimate was made in 1930 when the first unit, of similar size, was installed. Intermediate detailed estimates of cost with manufacturers' quoted prices were made in 1939 and 1946. The estimates for 1942 and 1947 were based on cost trends obtained from published cost indexes. Figure 2 shows the trend of these estimates. It is apparent that the unit investment cost has more than doubled since 1930 and that about 75 percent of this increase took place after 1939.

Another factor in raising costs is the longer time required by manufacturers for delivery of critical equipment, which has had the effect of prolonging the construction period. The result has been an increase in the over-all construction cost, with consequent higher overhead and interest charges included in the total investment.

Trend of Operating Costs

Operating costs for hydro plants have also followed a steady upward trend since 1937 because of higher wages paid to operators and skilled labor and higher costs of material and equipment used in maintenance. Figure 3 shows the trend in the cost of operation and maintenance per kilowatt of installed capacity for privately operated hydroelectric stations, as reported to the Federal Power Commission. The curve is based on composite costs of over 98 percent of the Class A and B privately operated utility companies in the United States. It will be noted that the ten-year period indicates an increase of 53 percent, but shows a flattening out of the curve in recent years. This trend is decidedly at variance with the sharp upward trend of labor and construction materials and indicates greater productivity and efficiency of operation.

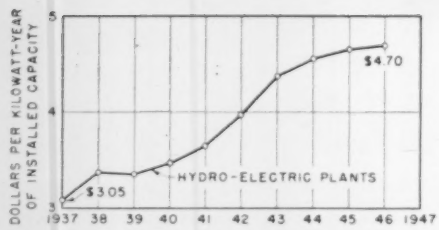


FIG. 3. TREND OF OPERATING AND MAINTENANCE COSTS of privately owned hydroelectric plants, from 1937 to 1946 inclusive, is indicated by curve based on composite figures reported to Federal Power Commission for Class A and B electric utilities in the United States.

Looking into the future while costs continue to mount steeply is perhaps crystal gazing, but the writer sees favorable signs for the continued development of good hydro sites located within reasonable transmission distance of the load and where the potential output can be effectively coordinated with other power sources to fit into the system load pattern.

The rising trend of labor and material costs has had a severe effect on steam plant investment and operating costs, principally because of the recent sharp advances in coal, oil and gas prices and the increased cost of transporting these fuels from their sources to points of consumption. Steam plants require more operators per unit of installed capacity than hydro plants, and consequently they have been more seriously affected by the higher cost of labor for operation. Since a hydro plant investment is usually large compared to a thermal plant investment for the same installed capacity, fixed charges constitute a larger proportion of the unit cost of hydro power. The fact that utility companies are now able to obtain reduced interest rates on capital for financing new plants results in proportionately lower fixed charges for the hydro installation.

As a result of these facts, and the ever constant threat of coal and transportation strikes to curtail steam production, the development of hydroelectric projects has received a new impetus. Sites formerly considered uneconomical when compared to steam are again being reviewed.

Present-day construction and operating costs are high when compared unit for unit with prewar and previous costs—but they are relative to the cost-of-living rise and the present value of the dollar. Basically, all plant costs are related to labor costs which, in turn, are reflected in commodity prices and the well-known "cost of living index." According to the U.S. Bureau of Labor Statistics, this index has risen from the 1935–1939 base of 100 to 163.8 in October 1947, an increase of about 64 percent.

The rising trend of operating costs has been moderated to some extent by increased efficiency and output resulting from refinements in operating procedure. Labor productivity in the electric power and light industry has increased substantially during the last ten years. The Bureau of Labor Statistics reports an index number of 89.6 for output per man-hour in 1937 and an index number of 160.2 in 1946—an increase of almost 80 percent in the productivity of privately owned electric light and power utilities, representing 81 percent of the industry.

It is obvious that at present the general trend of hydro power costs is affected by opposing forces. On the one hand, steadily mounting labor wage rates are tending to pull investment and operating costs upward and on the other hand engineers and operators are constantly striving to lower these costs.

The ascending spiral of labor and material costs has, of course, outdistanced the technological improvements and operating economies in hydro plants and it is inevitable that, if present high costs continue, rates for power must also increase. Utility companies are in the unenviable position of attempting to maintain rates fixed by regulatory bodies when costs of most items were well below present levels. Leading construction men predict that costs will continue at a high level and may not return to prewar levels for a long time. This prediction is based on their intimate knowledge of labor conditions and productivity, material prices, and competitive conditions. Also, strikes and demands for further wage increases to meet the rising cost of living are indicative of future trends.

Efficiency in design, construction and operation of new hydro plants must, of necessity, be the keynote if costs of generation are to be kept in bounds. Some of the more important means used to accomplish these objectives will be described briefly.

Means of Maintaining Low Hydro Unit Costs

Engineers and designers have reduced investment costs by more efficient design of hydro stations with reduced space requirements and the elimination of superfluous "non-revenue-producing" features. Some of the more important means of accomplishing this result are: Fewer units of larger capacity, higher-speed units under higher heads, more economical plant layout, reduction in space required for auxiliary equipment, economies in electrical layout, and reduction of operating villages to a minimum.

Improved Construction Methods

Improved construction methods and organization have also aided in reducing construction costs. It is significant to note that present-day costs of excavation and fill for large dams and powerhouses are not appreciably greater than they were years ago. This fact may be attributed to the larger capacity of earthmoving and rock-excavation equipment such as Tournapulls, crushers, motor graders, and to improved pneumatic tools, all of which have tended to alleviate the effects of higher labor costs. Improved methods of mixing, transporting and placing large volumes of concrete have also tended to offset higher construction costs. For small volumes of concrete, transit mixers have proved most economical in many cases. More efficient scheduling of equipment deliveries, inspection methods and expediting at the manufacturer's plant have tended to speed up construction and eliminate costly delays.

Efficient Operation and Improved Maintenance Methods

The higher cost of operating labor and maintenance materials has been offset to some extent by more efficient operating methods and improved maintenance procedures. For storage plants, reservoir operation is in accordance with rule curves established by exhaustive studies of experienced stream-flow data to assure primary power and energy output along with the maximum production of secondary energy during periods of surplus water.

Most hydro plant operators have learned by bitter experience that preventive maintenance, which involves taking care of critical equipment before trouble starts, not only reduces maintenance costs but increases reliability. Maintenance schedules are arranged so that equipment can be taken out of service for overhaul during off-peak or low-water seasons when it is not required for carrying load.

In recent years a great deal of research in the problems of cavitation on blade surfaces and adjacent parts has paid dividends in preventing pitting, which is a cause of reduced efficiency. The prewelding of runner-blade surfaces with stainless steel has been effective in lowering maintenance costs. Increased knowledge and use of welding for turbine construction and maintenance of equip-

...ent, and the adoption of sprayed ...etal for rebuilding worn surfaces ...ch as gate stems, shafts and seal ...gs, has tended to prolong service ...d reduce over-all maintenance costs.

To offset the higher cost of operating labor, remote control and automatic features of operation have been employed wherever feasible. Many older, high-production-cost stations have been converted to fully automatic or semi-automatic operation by the installation of devices for headwater gate control, turbine-gate regulation, voltage regulation and, in some cases, for synchronization and shutdown of units. These plants are equipped with adequate safety devices for overload, overspeed and machine protection. Automatic operation, a direct result of war conditions which made it difficult to obtain qualified operators, has proved desirable not only because it has reduced operating costs but also because it has proved more efficient than manual operation.

Rise in Power Generating Costs Calls for Restudy of Undeveloped Hydroelectric Sites

G. R. STRANDBERG, M. ASCE

Chief Hydraulic Engineer, Stone & Webster Engineering Corp., Boston, Mass.

PRESENTATION of data on cost trends in hydroelectric power generation is very timely as many undeveloped sites for hydroelectric developments as well as provisions for future units in existing stations are being restudied in view of the rapid rise in fuel costs for steam power stations and the extreme difficulty of obtaining delivery of steam-electric generating equipment.

For steam-electric plants, the cost of generating power and energy is divided about evenly between fixed charges based on investment and operating and maintenance costs including fuel. For hydroelectric plants, the fixed charges are more nearly from 80 to 90 percent of the costs, and the operation and maintenance charges are sometimes even less than 10 percent of the costs. In a period of rising costs the early construction of hydroelectric plants tends to decrease the effect of further cost increases because the maintenance and operation costs constitute a smaller proportion of the total costs in this type of plant.

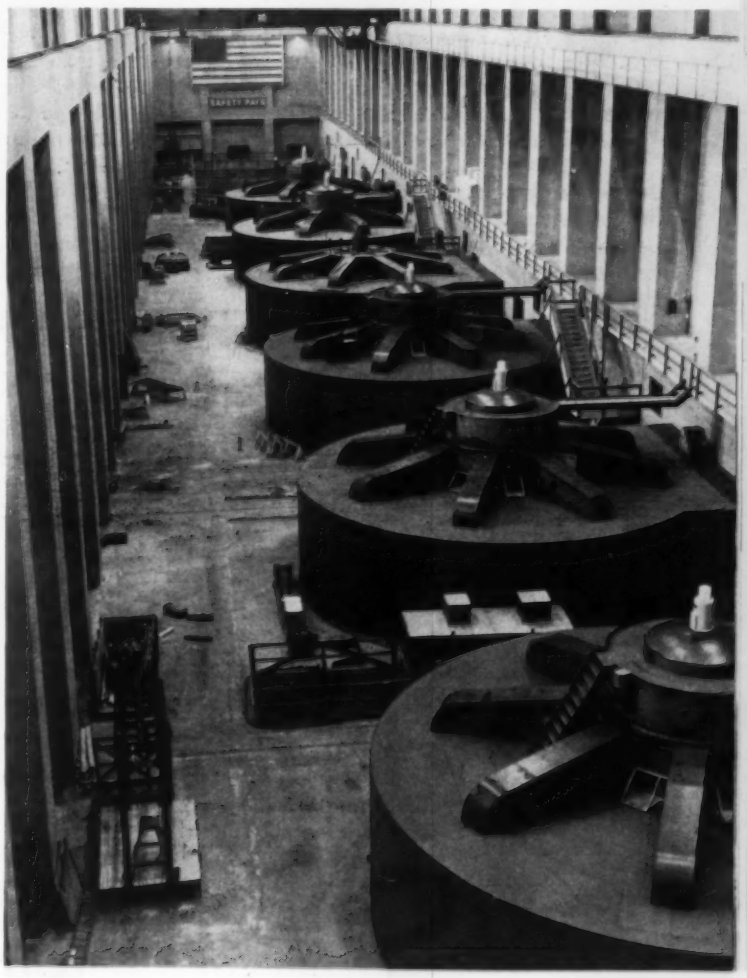
The major question, and probably the most important, is the determination of the time and point at which labor and material prices will level off and whether or not they will drop below present prices. Fuels have a tendency to increase in cost even with stable labor rates. In the case of coal, the higher-grade, more easily accessible veins are those first depleted, and in the case of oil, heavy demands require the opening up of more expensive oil resources. It is probable that interest rates, which determine the major cost of hydroelectric generated power, are as favorable to this type of power as can be expected.

Interconnected power systems have reached such size that available hydroelectric sites can, as a rule, be completely developed in one step and the output absorbed into the systems at once at some saving over step developments. As added capacity at a hydro plant generally can be installed at but a fraction of the cost of new steam capacity, new units may now be justified at existing plants where provision for future units has been made, especially where upstream storage has been increased or where the sites are adaptable to peak-load operation. Such additional units usually will generate fewer kilowatt-hours per year but if sufficient storage and pondage are available the units can be the equivalent of steam capacity on the peak of the load.

A review of the cost trends shown in Fig. 1 (page 24) for the period from 1930 to 1947, on a percentage basis, shows the following increases:

Item	Percent Increase
Common labor	123
Hydraulic turbine machinery	131
Pine lumber	93
Skilled labor	54
Waterwheel generators	94
Cement	30
Structural steel	50

Hydraulic turbine machinery and waterwheel generators have increased in cost much more rapidly than has skilled labor or basic steel. This increase may indicate the effect of overtime pay rates or a drop in the efficiency of skilled labor, or it may show that the labor rates used are not indicative of those applying to the manufacture of such equipment. It appears that rate changes for skilled construction labor have not agreed



GREATER PERCENTAGE INCREASE in cost of hydraulic turbines and waterwheel generators than in skilled labor or basic steel is indicated in period from 1930 to 1947. Pictured here are generators in west powerhouse, Grand Coulee Dam, integral part of Columbia Basin Project.

with those for skilled and semiskilled manufacturing labor.

That the trend of costs for hydroelectric station work is still upward is shown by two estimates prepared under the writer's direction in February and October of 1947 for an extension to a low-head power station. These estimates showed an increase of about 11 percent in over-all costs in that period.

Estimates prepared in April 1937, as against February 1947, for additional units at the same low-head power station, while higher than those in Fig. 2 (page 25) since they both included additional work on the dam, indicated an approximate check of the cost trend in Fig. 2 for such extensions to existing plants. The cost per kilowatt for such additions will, of course, vary for different heads and the amount of advance provision made at the time of the previous construction.

Referring to the trend of operating costs, it is probable that the flattening out of the curve in the three years from 1943 to 1946 was due to war controls. The labor-trend curves in Fig. 1 indicate a flattening for this period and the start of the sharp upward trend in 1946. The year 1947 will undoubtedly show a reversal in the curve of Fig. 3 as the sharp upward trend in labor rates was effective over the full year.

Means of Maintaining Low Hydro Unit Costs

On concrete dams serious consideration should be given to increasing the height of pours in order to reduce the number of horizontal construction joints, which require removal of laitance and roughening to give good bond. Even when thoroughly cleaned such joints are sources of disintegration from erosion or weathering. Pours as high as 50 ft have been found economical at some of the dams built in Ontario, and the increase in strength of forms required was not excessive since the initial set at the bottom of the pour reduced pressures as the depth of the pour advanced.

The cost of crest gates and headgates has increased very materially. With the larger extreme floods now indicated by many flood studies, consideration should be given to a low-cost type of gate or stop-log for part of the spillway capacity, to be operated only during extreme floods.

Use of gantry-crane hoists designed to operate all crest gates as well as headgates, stop-logs and racks will reduce the cost of gate hoists where many gates are required.

Omission of the superstructure over the units in a six-unit station built in 1929–1931 resulted in a saving of about $100,000. With present-day prices, the saving on a similar installation might amount to $250,000. The reduction in cost per unit would vary with the number of units, as the cost for end walls and the added cost for a gantry crane as compared with an indoor-type crane is the same whether there is one or more units.

World Economic Conditions Favor Hydroelectric Power Generation

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and

J. I. METCALF
Commercial Power Department, Harza Engineering Co.

MECHANICAL POWER, which includes electrical power, is largely responsible for modern comforts of living. In fact, the amount of developed power per capita has become the most definite index of the standard of living and of the state of civilization in every country and community in this industrial age.

Three factors are stimulating the development of hydroelectric power throughout the world:

First, hydroelectric power costs much more to build, but less for labor and fuel to operate, than fuel-burning electric plants. For this reason present low interest rates and high labor and fuel costs favor hydroelectric power as contrasted with fuel-electric power. Twenty years ago the reverse was true.

The second and much greater factor contributing to the present world-wide urge for the development of hydroelectric resources is the critical world fuel situation. The areas without coal such as Switzerland and Italy, as well as other areas of Europe, were formerly dependent largely upon German coal. Other areas of Europe and many distant parts of the world without coal such as Argentina and Uruguay were always dependent upon British coal, often as return cargoes from shipment of cattle and wheat. England, because of shorter working hours and labor inefficiency, can no longer fill her own coal requirements, much less supply much of the world as formerly and this situation arises at a time when coal production in England is necessary to avoid economic catastrophe. Parts of the world formerly dependent upon British and German coal are industrially starving for lack of it. The rate of recovery of Europe from the effects of the war is almost exactly measurable by the rate at which the production of German and British coal can be restored.

The third factor stimulating hydroelectric development in areas without coal or other fuel is the desire for greater self-sufficiency in time of war or other emergency. During the war Buenos Aires and Montevideo steam stations burned enough wheat and corn every day to feed all of Holland, all of Belgium and a large part of France. They do not want that to happen again.

And even in the United States we are victims of a war of nerves regarding our own coal supply and its cost, precipitated periodically by that great but unintentional friend of hydro power development, John L. Lewis.

Regarding the status of liquid fuel, we hear repeated warnings of the depletion of our United States supplies and our dependence more and more upon imports. Only recently the restoration of gasoline and oil rationing was threatened by our government to relieve a possible fuel famine in the United States. There have been no major new oil discoveries in the United States for many years. The diplomacy of the world now centers around control of the remaining known oil reserves of the Near East. There is now a world-wide fuel shortage. If the world keeps on doubling its power consumption every ten years where is the fuel coming from?

Is it to be wondered at that the world is hydroelectric-power conscious as never before, and that plans are afoot in nearly every country of the world to put the streams to work?

It is the responsibility of engineers to strive constantly for the lowest possible investment and the best possible operating results. But we must be realistic and admit that no conceivable improvement in construction methods, design or equipment can

produce any marked offset to a doubling of price levels, such as we have witnessed in the last decade which is common to both fuel and hydro development, but affects hydro more than steam because of the greater proportion of capital charges.

Mr. Salzman states that theoretical competitive cost analyses for independent fuel vs. independent hydro installations are no longer the vogue. The growing realization of the artificiality of such costs has had a most pronounced effect on the attitude toward new hydro construction, by completely changing the conception of power and energy classifications from a plant basis to a system basis. Further information on changing cost conceptions, with particular emphasis on hydro, would help clarify the subject.

Another important trend is in the treatment of depreciation as a cost. The accumulation of long-term experience has produced a marked change in the treatment of this element of cost in hydroelectric facilities—so much so that the so-called "service-life" approach is no longer valid. In fact, the revenue-bond method of financing public projects has opened up a whole new field of accounting theory for hydro projects, under which a small provision for renewals and replacements is combined with long-term amortization of the capital investment. This in turn is influencing the attitude of corporate managers.

Rise in Fuel Costs Stimulates World-Wide Hydro Development

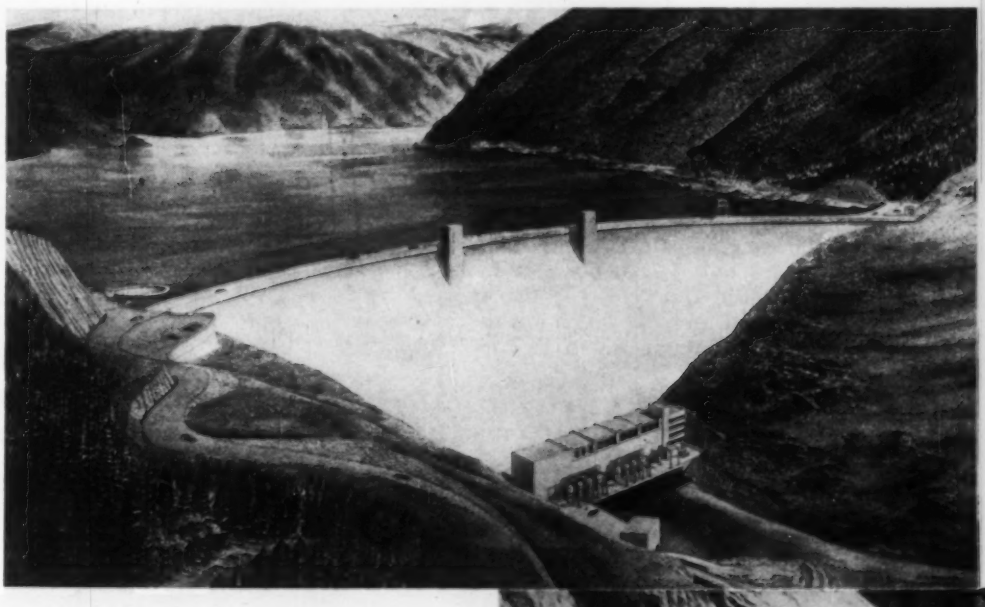
Closing Discussion by M. G. Salzman, M. ASCE

THE WRITER is indebted to Mr. Strandberg and Messrs. Harza and Metcalf for their discussions which amplify several of the more important points brought out in his paper. Mr. Strandberg has supplied several examples from his own experience which are indicative of present hydro-plant cost trends and the benefits to be derived from the development of low-cost incremental hydro units in existing plants to operate on the peak portion of the load where kilowatts of capacity are required but few kilowatt-hours need to be generated. It is evident that his company is fully cognizant of the savings obtainable by the omission of expensive superstructure in the outdoor-type station.

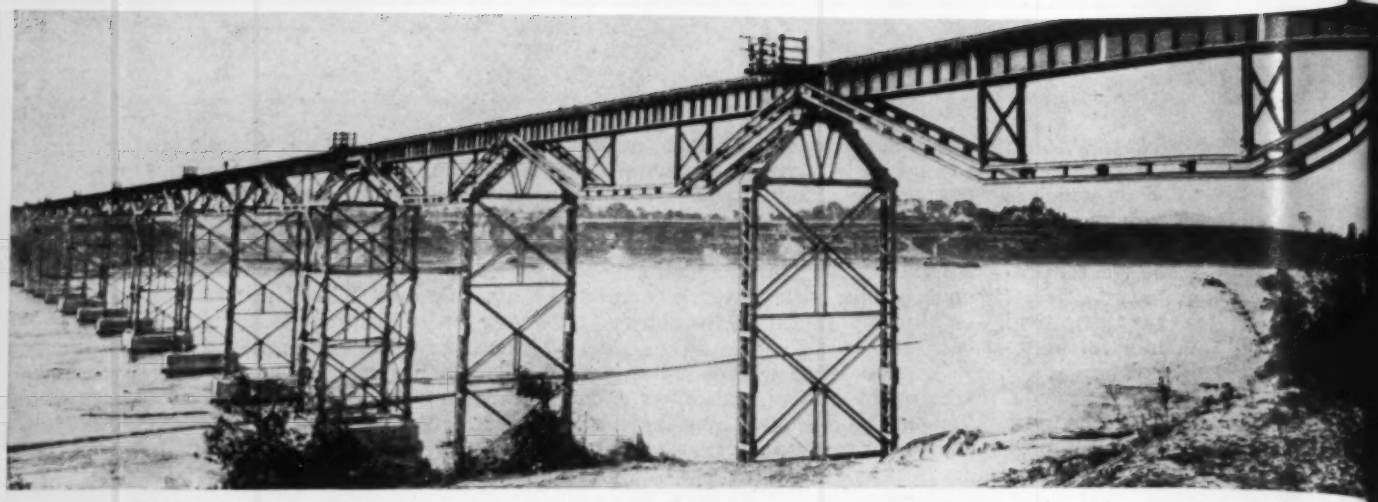
Mr. Strandberg calls attention to the fact that the trend curves for hydraulic turbines and waterwheel generators have risen more rapidly than those shown for basic steel and skilled labor. This rise, he states, may be due to the omission of overtime pay rates in the labor costs, or to a drop in the efficiency of skilled labor, or to the fact that the trend curves are not indicative of the type of labor and materials used for manufacturing these products. Recent information received from the U.S. Bureau of Labor Statistics since the paper was prepared indicates that the average straight-time hourly earnings of labor in the hydraulic turbine industry have increased about 66 percent from 1940 to the end of 1947, and the average cost of combined materials used in the manufacture of turbines has increased about 71 percent during this same period. According to Fig. 1 (page 24), the cost trend of hydraulic turbines has increased approximately 60 percent since 1940 so that it is apparent that the manufacturers are not reaping any great profits from the increased prices.

Messrs. Harza and Metcalf have very appropriately commented on the critical world fuel situation which favors the development of hydro power in many foreign countries, both for the purpose of conserving fuel reserves and to utilize their own water resources. The writer returned recently from a trip to the new Republic of the Philippines where the high cost of imported coal and oil makes it almost mandatory to develop available low-cost hydro power to stimulate industrial rehabilitation and growth. The fact that an appreciable portion of our fuel reserves is being sent abroad is further reason for promoting world-wide hydro development.

Regarding comparative costs of hydro and fuel-generated energy, it must be realized that general comparisons are often misleading and to the writer's mind are best omitted unless they can be applied to specific cases. For example, in the Southwest present costs of gas-fired steam power and energy are considerably lower than equivalent hydro costs. On the other hand, in the Northwest region, which is remote from productive fuel sources, hydro can be developed at a much lower cost than thermal power. Mr. Harza has also called attention to the new concept of depreciation as an element lowering fixed carrying charges of hydro developments. With present improved maintenance techniques for hydraulic structures and equipment, the life of hydro stations can be prolonged almost indefinitely and is usually limited only by obsolescence.



PRECONSTRUCTION WORK ON HUNGRY HORSE DAM on South Fork of Flathead River, 9 miles southeast of Columbia Falls, Mont., is now under way. Bureau of Reclamation project will be fourth largest concrete dam in world. When completed, dam will provide much-needed power for Pacific Northwest, flood control, irrigation water for western Montana lands, and stream regulation for Columbia River. Specifications provide for construction of concrete arch dam 520 ft above foundation, 2,115 ft long, with arch radius of 1,200 ft. Approximately 3 million cu yd of concrete will be required for dam and appurtenant structures. Powerplant housing four 75,000-kva generators will be constructed at toe of dam. Diversion tunnel, 36 ft in diameter and 1,100 ft long, is now under construction.



BENTS BUILT ENTIRELY of dismantled steel rails and sheetpiles feature Liuchow Bridge, 1,905-ft-long, 66-ft-high crossing on China's Hunan-Kwangsi Railway. Bridge contains total of 18,600 yd of 85-lb rail, 500 yd of 35-lb rail and 4,160 yd of 12-lb rail. Construction began in October 1939 and was completed in December 1940.

China Rebuilds Her Railroads

P. C. LEE, M. ASCE

Engineering Adviser, Chekiang-Kiangsi and Canton-Hankow Railways, China*

AS THE TRANSPORTATION arteries of a nation, railways are essential to the prosperity of a country. In the historic development of the United States the railroads were the pioneers, the trail blazers, carrying the torch of civilization, making the vast regions accessible to mining and industry. Dropping far behind the United States, with its tremendous railroad network, is China, with almost the same area and a far greater population, but only 30,186 km (18,757 miles) of railroads. Need for outside aid in rehabilitating this war-torn nation's railroads—devastated by war and paralyzed from lack of rolling stock and materials for repair and maintenance—is emphasized in this summary of the major problems involved.

A COMPARISON of the railway mileage of China with that of the United States (Table I), clearly indicates that China has very inadequate railway coverage. Further, the limited mileage it does have is not evenly distributed over the entire country. In China's vast interior provinces, including Sinkiang, Tibet, Tsinghai, Sikang and Szechwan, an area of about 1,692,000 sq miles is completely devoid of railroad facilities (Fig. 1). Almost four-fifths of the country's existing railroads are located in the coastal area.

Even today this totally inadequate system is not in full operation. Eight years of war caused tremendous damage to all the railroads in China. Permanent ways were dismantled; bridges and tunnels were blown up and locomotives and rolling stock were practically all destroyed. Of the 30,186 km of prewar and wartime-built railways, only 13,605 km were in operation at the end of 1947 (Table II). This total includes 3,925 km in Formosa, the strategic island in the South China Sea. Only two major lines are now open to through traffic—the Peiping-Suiyuan in the north and the Canton-Hankow in the south. Continued paralysis of rail lines does more damage to the nation's economy than any other factor in this war-exhausted country.

The United States was one of the leading pioneers in railroad construction. Although its railroads were sometimes built under very difficult and trying conditions, its engineers were able to marshal the necessary resources, supplies and engineering knowledge to accomplish their aims.

The harrowing conditions under which Chinese engineers were forced to build their lines and conserve their supplies called forth unequaled resourcefulness and ingenuity born of the necessities of war. Their efforts probably have never been equaled in the history of railroad construction and the results they achieved might well be termed the railroad miracle of the age. At the outbreak of the war with Japan, China's railroads, like the country itself, were totally unprepared for the traffic burdens of war. The country's total trackage consisted of less than 10,000 miles of comparatively light rail, ranging from 35 to 100 lb with an average of about 75 lb, hardly sufficient for heavy traffic.

On China's railroads bridge loadings vary from E-20 to E-40; equipment, locomotives, and freight cars are light. Many of the railroads have no signal facilities; in fact, only a very few of the principal lines are equipped with anything approaching modern signal equipment.

Railroad lines were always principal military objectives and at the end of five years of war, China had lost in all 6,566 miles of railroads, leaving but about 1,744 miles in the area of free China. The obstacles to building railroads and maintaining wartime traffic without supplies of any sort would seem insurmountable to most railroad engineers. Yet the Chinese

TABLE I. CHINA'S RAILROAD MILEAGE COMPARED WITH THAT OF THE UNITED STATES

Country	Area, Sq Miles	Population	Total Ry. Mileage*	Miles of Railway Line: (A) To Each Million of Population	Miles of Railway Line: (B) To Each 10,000 Sq Miles of Area	% of U.S.: For (A)	% of U.S.: For (B)
United States	3,022,387	131,669,275	229,174	1,740	7,600	100	100
China	3,869,001	458,257,965	18,757	41	485	2.4	6.4

* Mileage of United States railroads is based on 1942 figures, and mileage of Chinese railroads is based on 1946 figures.

* Formerly Professor of Railroad Engineering, National Northwest College of Engineering, China; Chife Location Engineer, Hunan-Kweichow Railway.

TABLE II. STATUS OF RAILWAYS IN CHINA, AT END OF 1947, IN KILOMETERS

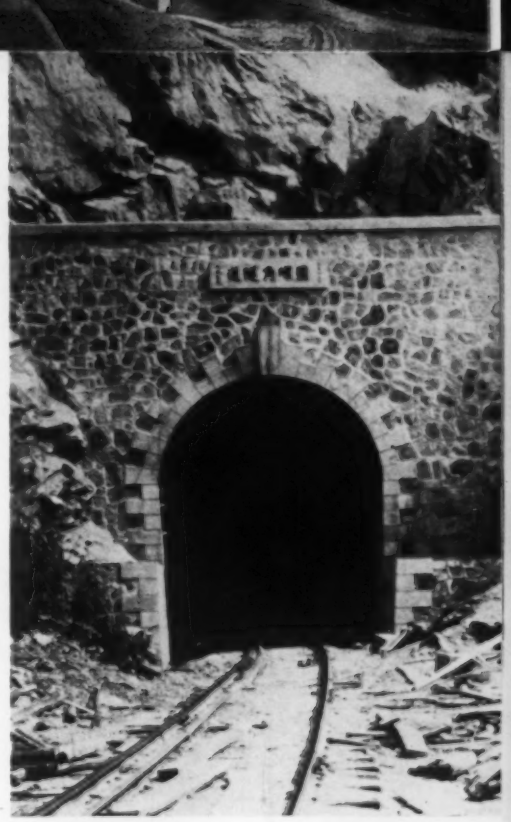
Section of China	Total Length	Lines in Operation	Dismantled in War and Not Repaired, or Disrupted by Communists
Northeast (Manchuria)	11,335	1,057	10,278
North China	8,527	4,050	4,477
South of Yangtze	6,110	4,387	1,723
Taiwan (Formosa)	3,925	3,925	...
Hainan	289	186	103
Totals	30,186*	13,605	16,581

* Of this total of 30,186 km, 24,932 km is standard gage, and 5,254 km is narrow gage.

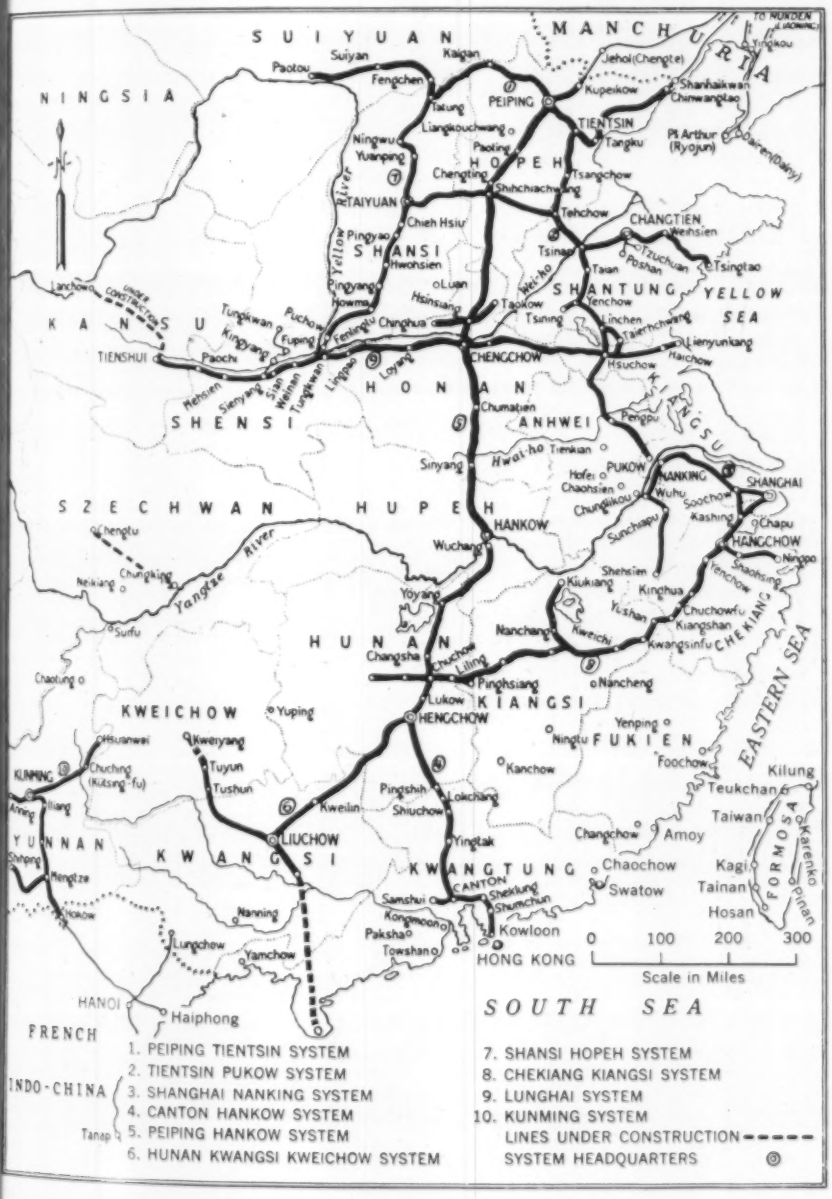
were able not only to quickly mobilize their resources for the dual purpose of moving troops to the front and evacuating civilians and industrial equipment to the interior, but also to carry the greatest traffic load known to that country.

During the first five years of the war, the railroads transported over 11,000,000 soldiers and civilians and more than 2,860,000 tons of military supplies and other equipment. Unlike American railroads, the Chinese lines were never equipped to handle heavy traffic.

Historic achievements in railroad engineering include completion of the only east-west line—the Chekiang-Kiangsi Railroad—two months after the opening of hostilities, and its excellent performance in maintaining transportation service under constant bombardment and strafing by the Japanese air force. This line completed the link between the major cities of Shanghai, Canton and Hankow in the strategic war area. It also made possible the now historic defense of Shanghai in 1937. During this period the railroad transported tens of thousands of soldiers to the Shanghai area and moved thousands of civilians, as well as whole industries, from the east coast area to the southwest interior of China, thereby maintaining some semblance of war production.



SEEMINGLY INSURMOUNTABLE obstacles in constructing railroads without equipment and materials are encountered by Chinese engineers. Pictured here is north portal of restored 820-ft-long Yuan-Lou-Chou Tunnel on Canton-Hankow Railway.

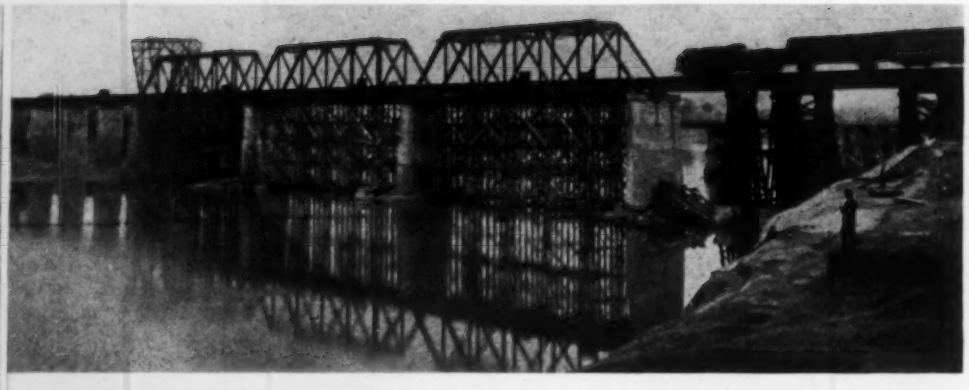


Widespread Destruction Suffered

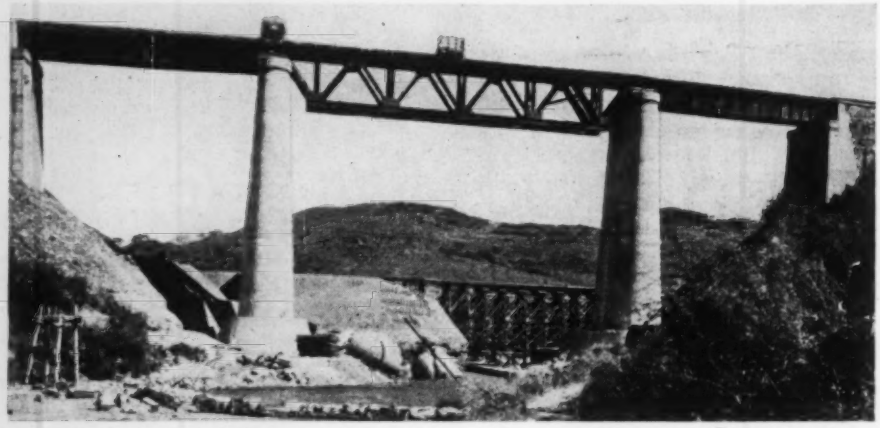
Unfortunately, the overpowering force of the enemy invasion finally caused the destruction of these defenses and the final dismantling of the railroad. At the end of the war, only 160 km out of the original 1,200 km of this line were in limited operative condition.

More important and more precious than any war material were the rail-

FIG. 1. CONTINUED PARALYSIS of large part of China's 18,757 miles of railways is major deterrent to nation's economic recovery. Many railways on which traffic was resumed at end of Japanese hostilities are again inoperative because of Communist military activities.



DEMOLISHED IN WAR, 1,004-ft structure over Loh River on Canton-Hankow Railway is restored to service January 15, 1947.



COMPLETELY DESTROYED during war, except for abutments, bridge over Sao Chi River on Canton-Hankow Railway is restored by reconstruction of piers, deck truss and girder spans.

roads. Thus when the Chinese army withdrew, it always dismantled and salvaged every possible piece of railroad equipment available. The ingenuity of the Chinese engineers was demonstrated by some of their salvage operations in which they used every piece of available scrap iron to build new railroads, such as the Hunan-Kwangsi-Kweichow and the Paochi-Tienshui lines. In fact, one of the largest bridges in Liuchow on the Hunan-Kwangsi line, over 1,905 ft in length and 66 ft in height, was built entirely of salvaged materials, a feat never before attempted, but made necessary by war. This bridge is shown in an accompanying illustration.

Among China's wartime railway construction undertakings the most highly praiseworthy is the completion of the Hunan-Kwangsi and Kwangsi-Kweichow lines, now in the Hunan-Kwangsi-Kweichow System. Both lines added the largest effort to the fighting on the most important southwest front.

The Hunan-Kwangsi line extends from Hengyang to Liuchow, a distance of 535 km and the Kwangsi-Kweichow line from Liuchow to Tuyung a distance of 470 km connecting the existing Canton-Hankow Railroad with the interior of the mountainous Kweichow province, never before touched by railroads. The first section of the Hunan-Kwangsi line was completed in twelve months at a speed of 1 km a day—a record in Chinese railroad building.

The completion of this section within the scheduled time was largely due to the unstinting cooperation of the provincial governments. With the exception of difficult rock work, the roadbed was built entirely by workmen conscripted by the labor departments in Hunan and Kwangsi. Some 140,000 laborers were conscripted from districts extending 10 miles on each side of the railroad, persons between the ages of 16 and 45 being called to work for a period of 30 days.

Work in Difficult Terrain

The railway lines in the southwest pass through difficult terrain characterized by high hills, steep passes and thinly populated, undeveloped areas. This is particularly true of the Kwangsi-Kweichow Railroad, the construction of which had to be preceded by the building of highways in order to make possible the transportation of materials and equipment. The difficulties encountered in building this line were unparalleled in the history of Chinese railroad construction. It passes through a territory crisscrossed by mountains and streams, similar topographically to the Alleghenies in the United States, particularly along the border between Kwangsi and Kweichow provinces, where the long ranges of mountains presented formidable obstacles to location.

To meet the difficult topographic conditions, the route was selected for a maximum grade of 2.7 percent, including compensation. It was planned to use powerful locomotives to overcome the grade.

FIG. 2. REVENUES and operating surplus of three representative lines serving different parts of China show earning capacity of Chinese railroads.

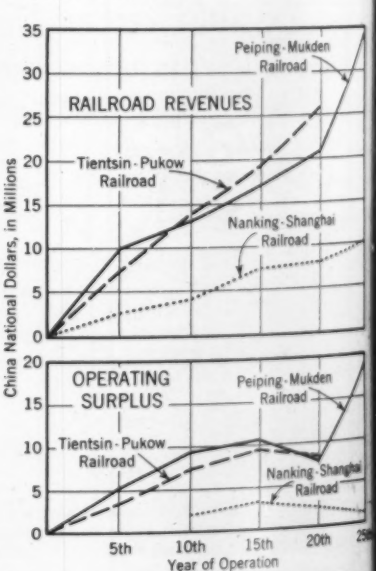


TABLE III. STATUS OF RAILWAYS SOUTH OF THE YANGTZE, AT END OF 1947

Railroad System	Total Length, Km	Percent Operative at End of War, Aug. '45	In Operation at End of 1947 Km	In Operation at End of 1947 %	Dismantled, Requiring Rehabilitation, Km	Remarks
Nanking-Shanghai-Hangchow-Ningpo	663	77	508	77	155	.....
Chekiang-Kiangsi	1,140	14	871	76	269	.....
Nanking-Kiangsi	669	20	0	0	669	Rails removed for restoration of another line
Canton-Hankow	1,355	0	1,355	100	0	.....
Hunan-Kwangsi-Kweichow	1,071	19	1,007	94	64	.....
Kunming	823	78	646	78	177	Narrow-gage region
Miscellaneous	389	..	...	..	389	.....
Grand total	6,110		4,387		1,723	

MBER TRESTLE is one of many restored ctures which permit through traffic on nton-Hankow Railway in South China. ly one other major railway line, Peiping-yuan in North China, is now open to ough traffic.

The engineering characteristics of is section from Kinchinkiang to weiyang, based on two different jected routes with different stand-ds of grade, are summarized for mparison as follows:

Item	Line A	Line B
ding grade	1.5% compensated	2.7% compensated
stance	472 km	447 km
rthwork (grading)	27,000,000 cu m	15,000,000 cu m
ck excavation	17,000,000 cu m	6,000,000 cu m
nnels	10,628 m	7,479 m
ducts	1,000 m	None
dges (large)	1,200 m	1,200 m
dges (small)	980 m	800 m
verts	10,000 m	6,000 m
es	23,000 m	18,000

Since the railroad had to be rushed completion because of the pressure war, it was decided to use the line ith the steeper grade, so as to reduce a minimum the investment in bor and capital and the time re-ired for construction. This line, ith its terminus at Tuyun, was com-eted early in 1944.

Despite all the difficult engineering atures, the work was done with mple and poor equipment much the me as that used in building the old urma Road or even worse. It is of terest to note that this railroad was ntirely built with dismantled mate-ials and rolling stock evacuated om other dismantled lines and oved, some of it a thousand miles, om the fighting front to the place of onstruction. More than 20 different inds of salvaged rails, with sections rying from 60 to 90 lb, were used, s obtained from the various aban-oned lines. Because of the shortage iron and steel the project proved to e the most difficult construction ituation Chinese engineers have ever faced. That the goal of completion was eventually reached is a tribute to their perseverance, diligence and concentration.

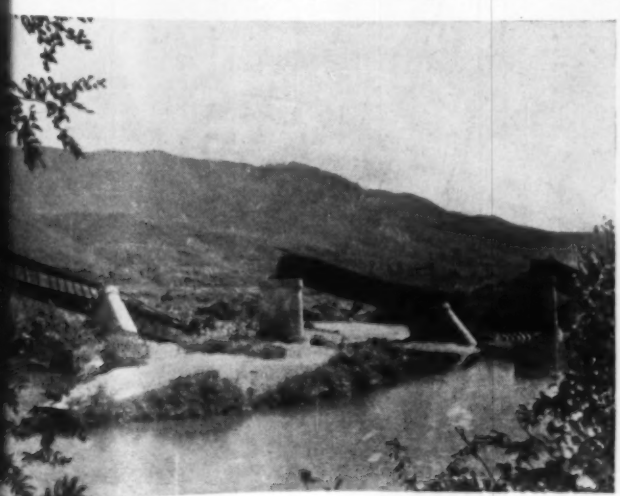
Operation as well as construction presented serious problems but these too were solved. In lieu of lubricating oil, vegetable oil was used. Coal was mined near the new railroad lines but it was not always available and the quality was extremely poor. When there was no coal, timber was used. In fact, nothing was wasted, and operation was constantly maintained. The accomplishments of these Chinese engineers should be recorded as one of the outstanding illustrations of resourcefulness and determination in railroad history. Indeed, it is a feat which has won the complete and profound admiration of American engineers.

Rehabilitation in Manchuria and North China

With the close of the war, the country was confronted with a stupendous rehabilitation task which in fact it still faces. Realizing that economic recovery is contingent upon an efficient transportation system, the Chinese Ministry of Communications is undertaking to marshal all possible resources and power to rebuild China's war-torn rail lines. The immediate problem is the acute shortage of track and structural materials as well as of construction equipment and rolling stock. Chinese railroad engineers are still facing the problem of restoring the railroads—the nation's life—without the necessary supplies and materials.

As early as the beginning of 1946, the Ministry of Communications prepared plans for reconstruction work on the five main railway lines in North China. Failure to reach an armistice with the Communists and their continued military activities put innumerable difficulties in the path of this project. During the last quarter of 1946, however, considerable progress was made in repair work. A total of 1,600 km of track and 393 bridges were renovated along the Tientsin-Pukow, Peiping-Hankow, Tsinan-Tsingtao, Taiyuan-Shihchiachuang and Peiping-Suiyuan Railways. Both the Peiping-Suiyuan and Tsinan-Tsingtao lines were completely restored by the end of 1946. Traffic was resumed on the northern section of the Tientsin-Pukow line between Tientsin and Tsangchow in Hopei. The Peiping-Hankow Rail-

ANY MILES OF DESTROYED AND DISMANTLED RAILROADS in China are result of Japanese invasion. Salvaged equipment was reused y Chinese engineers in building new railroads in South China. At end of war only 160 km of original 1,200 km of Chekiang-Kiangsi Rail-ay connecting major cities of Shanghai, Canton and Hankow were operative. Photos below show Shwan-lao-wan Bridge on Canton-ankow Railway as demolished (left) and as temporarily restored (right).



EMERGENCY MEASURES have restored Canton-Hankow line to meet nation's desperate transportation requirements. Line is now operating at limited efficiency. Picture shows demolished 131-ft-high pier of Chang River Bridge, highest crossing on Canton-Hankow Railway.

way was open on the south end from Hankow to Fenglocheng on the Honan-Hopei border and from Peiping, the north end of the line, to Paoting in Hopei Provence. Resumption of traffic was effected over the entire length of the Taiyuan-Schihchiachuang line and over the Hsuchow-Chengchow section of the Lung-Hai Railway. Since then, as a result of Communist activities in 1947, a large part of the northern railroads has again been reduced to an inoperable condition, with the exception of the Peiping-Suiyuan line. By the end of 1947, of the 8,527 km of railroads in the north only 4,050 km were in operation.

In the Northeast (Manchuria), railways taken over and operated by the national government before the end of 1945 only amounted to 289 km. By the end of 1946, the total was increased to 3,039 km in full operation. Again, at the end of 1947, the lines in operation were reduced to 1,057 km as a result of Communist military activities in that part of the country.

Rehabilitation South of the Yangtze

The railway system south of the Yangtze River consists principally of six lines, the status of which is summarized in Table III. Of the total 6,110 km only 4,387 km were in operation at the end of 1947. Railways south of the Yangtze comprise nearly one-third of the total mileage in China south of the Great Wall. With the exception of the Yunan-Indo-China line, which is in the remote border province of Yunan, all southern railways are interconnected with standard-gage track. They link China's principal seaport, Shanghai, with the South China trading center, Canton, and the cities of Wuchang-Hankow in the heart of the Yangtze Valley. As a system, these lines form the main highway connecting the industrial centers of the Yangtze delta with the southwest interior. They also traverse a fertile area of approximately a half million square miles, containing a population of some 200,000,000 and including the principal sources of rice, tea, silk, pottery, wine, meats, fruits, tung oil, lumber and also some important mineral ores such as tin, tungsten, antimony and iron.

Coal is produced in several important centers scattered over this area, where the only line now in operation and in fairly good condition is the section between Nanking, Shanghai and Hangchow of the Nanking - Shanghai - Hangchow - Ningpo line, which has almost regained its prewar level of operation. None of the other lines can be operated at normal capacity. The Canton-Hankow line has been restored, using all possible emergency measures, to meet the nation's most desperate need of transportation, and is now operating at a very low efficiency. The remaining lines are not in full-scale operation since large portions of them were dismantled and have not been rehabilitated. Despite all difficulties due to shortage of materials and equipment, the Chinese Ministry of Communications is doing everything within its power to restore this south railway system, which is of course not directly affected by the civil strife in the north.

A review of Table III shows that 1,865 km of railways have been restored since the close of the war. Rehabilitation to this extent was accomplished partially with supplies received from UNRRA, through U.S. Export–Import Bank credit, and through the Canadian loan. These funds, however, were hardly adequate to meet all repair needs. As was done during the war, the engineers solved the problem partially by making use of substitutes and temporary structures. The achievement represents a tremendous amount of materials, labor and sacrifice. For example, a section of track more than 100 km long on the Nanking-Kiangsi Railway was removed in the latter part of 1946 to make up the acute shortage of rails and accessories for the desperately needed restoration of a more important line.

Dearth of materials, of course, has been the chief obstacle to the rehabilitation program. Moreover, with the Communists holding almost all of Manchuria and disrupting industry in North China, the government is giving top priority to developing a new industrial base in an area that is relatively free from Communist interference. The vast project to develop South China depends on the rebuilding of the Chekiang-Kiangsi, Canton-Hankow and Hunan-Kwangsi-Kweichow Railways.

Outside Aid Mandatory

At the end of World War II, dismantled lines in the territory south of the Great Wall totaled about 7,000 km in length. Damage to these lines, particularly in the southern part of China, appears to be of greatest magnitude. Besides the complete destruction of roadbeds and structures, much of the rolling stock in all invaded territory was taken over by the enemy for military operation during the war years and of course suffered through lack of proper maintenance and handling. Moreover, before surrendering, the enemy carried out a tremendous program of destruction. Those cars and locomotives returned were usable only after extensive repairs. Since the

TABLE IV. SPECIFIC REQUIREMENTS FOR REHABILITATION AND MODERNIZATION OF WAR-TORN RAILROADS IN CHINA

Item	Amount in Millions of U.S. $	Quantity	Initial Requirement in 1948	Requirement in 1949	Requirement in 1950
Rails & accessories	90.00	900,000 tons	300,000	300,000	300,000
Timber ties	36.00	12,000,000 pcs.	4,000,000	4,000,000	4,000,000
Bridge steel	28.00	140,000 tons	70,000	35,000	35,000
Construction equipment	12.25	8,750 tons	4,000	3,000	1,750
Shop machinery	14.00	10,000 tons	7,000	1,500	1,500
Locomotives	80.00	800 pcs.	400	200	200
Passenger cars	80.00	1,000 pcs.	600	200	200
Freight cars	52.00	8,000 pcs.	4,000	2,000	2,000
Steel for rolling-stock repairs	24.00	120,000 tons	60,000	30,000	30,000
Signal & tele-communications equipment	20.00	...	10.00	5.00	5.00
Terminal & station facilities	13.75	...	7.00	3.75	3.00
Total	450.00				

king over of the railways by the tional government, locomotives and her rolling stock have been re-abilitated as rapidly as possible, uch of it by "cannibalizing" parts r cars and locomotives from other milar equipment.

During the occupation years the aintenance of almost all the lines perated by the enemy was com-letely neglected. Rehabilitation of hese lines is as urgent as that of the ismantled lines. Furthermore, to eet present heavy traffic demands, me of the major lines must be odernized. Trains of the Nanking-Shanghai line are continually so rowded that even standing room is a premium. This is an indication f the need for additional track and lling stock as well as for the in-reased operation capacity that could e secured by the installation of odern signal facilities.

Thus it has become clear that hina must restore her dismantled nes, rehabilitate those which have isintegrated, and modernize those hich are subject to heavy traffic. nless such rehabilitation is accom-lished, the disintegration of her conomic structure will continue. nly through outside aid can this bjective be accomplished. The hinese engineers are indomitable but ey have run out of substitutes.

Table IV lists requirements mounting to approximately $450 illion in United States dollars which an easily be the difference between uccess and failure in attaining the ommon objective of both the United tates and China—a free, prosperous, emocratic nation.

China's Needs Clarified

1. **Rails.** Besides the require-ent for the restoration of dismantled acks, there is an acute shortage of ail for the replacement of worn-out ack in lines under operation, the tal being approximately 900,000 ons of 90-lb rail with accessories.

2. **Locomotives and Rolling tock.** There is a serious shortage of otive power in all lines under opera-on. Like the lack of passenger and eight cars, this shortage is a bottle-eck which affects the country as a hole.

3. **Repair Problem.** It is obvi-sly the large number of damaged comotives and cars that is responsi-le for the shortage of serviceable tock. The inability of the railroads reduce this backlog has two auses—shortage of repair materials nd lack of repair facilities. Many ieces of equipment are seriously amaged and difficult if not impossi-ble to repair because of the lack of spare parts. Plants have been destroyed and steel is in short supply. With the necessary supplies at hand, it is assumed that 40 percent of the damaged equipment can be repaired and made serviceable.

4. **Cost.** The estimated figure of $450 million includes expenses for ocean freight from the United States to China. With this amount appropriated, the transportation capacity of Chinese railroads will be slightly above the prewar level.

Future Prospects of Chinese Railroads

A review of prewar records discloses that most of the Chinese railways were operated at a profit. The combined revenues in 1937 for the first six months of the year were (in Chinese National Dollars) CN$91,852,000, with operating expenses of CN$43,899,000 during the same period. The operating ratio during the first six months of 1937 was 48 percent, representing an operating profit of $0.52 for every $1.00 of operating income. The corresponding operating ratio in the United States for the year 1939 was 73 percent.

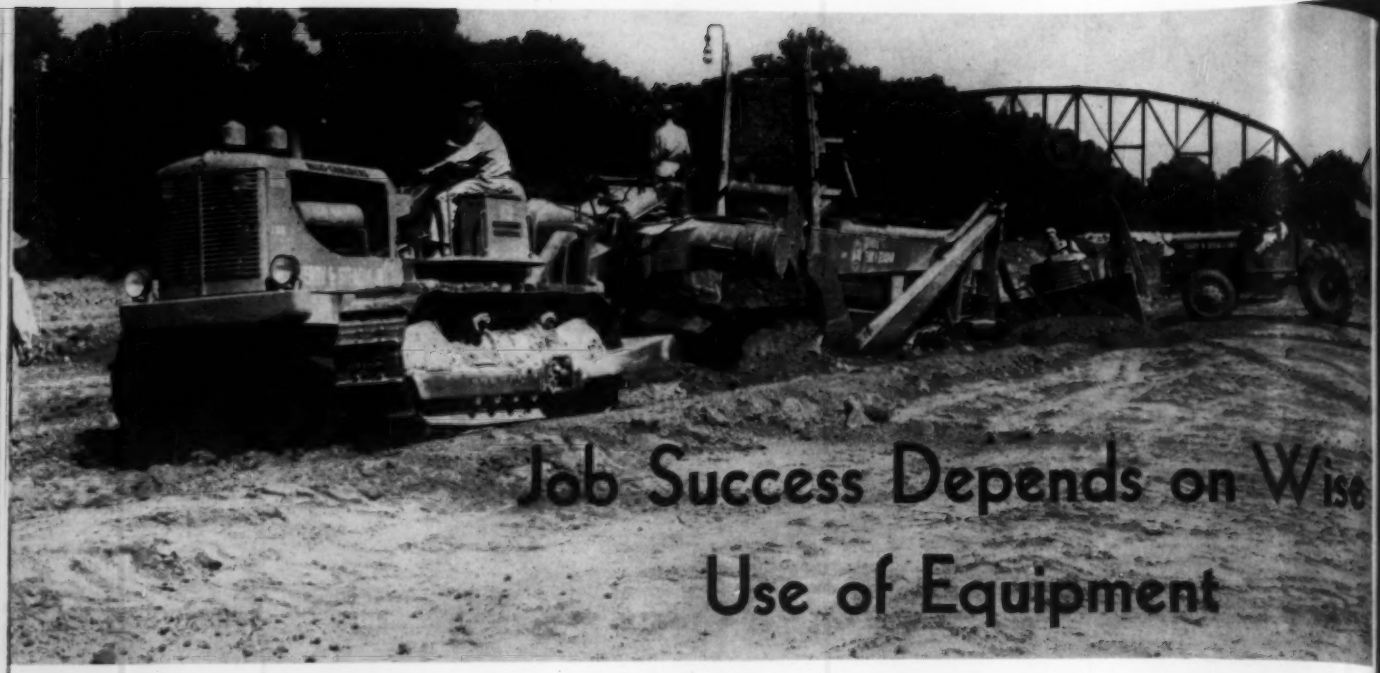
The earning capacity of Chinese railroads is illustrated by examining three representative lines which serve different parts of the country and operate under varying competitive conditions: The Peiping-Mukden line which runs through North China and faces no competition; the Nanking-Shanghai line, which serves the Yangtze estuary and is exposed to shipping competition; and the Tientsin-Pukow Railway, which has a competitive position approximately the average of the other two. The operating revenue and operating surplus trends for these lines are shown in Fig. 2.

Substantial railroad revenues in China were due principally to the large territory and huge population served. In fact, the virtually monopolistic nature of each railroad in its respective area has not been changed and will remain for a long time to come, until China can develop a large-scale railroad network. It will probably take more than half a century for the materialization of long-range projected plans. Moreover, unlike America, the highways in China were not planned to compete

(*Continued on page 74*)

British Convert Airfield Paver to Highway Use

FIRST USED ON AIRFIELDS during war, British road-laying machine now resurfaces highways at rates ranging from 8 to 44 ft per minute, depending on thickness and width of surfacing. Asphaltic material dumped from truck into hopper of machine is spread and tamped to uniform density correcting irregularities in road subgrade. Machine is shown placing new asphalt surface on Constitution Hill, London.



Job Success Depends on Wise Use of Equipment

IDLE MACHINERY—whether idle because of weather conditions, lack of work, or mechanical failure—does not earn money. Equally true is the fact that unless machines are worked in an efficient manner, the owner does not get the full benefit from his investment. Intelligent application of construction equipment is usually the factor that determines the economic success or failure of a job. These notes are prepared by the Allis-Chalmers Civil Engineering Department, Tractor Division.

MORE THAN 1,000,000 CU YD OF DIRT is moved on Louisville's $18,000,000 levee project in constructing two sections of earth wall that in many places exceeds 20 ft in height. Almost 200,000 cu yd of dirt moved cannot be used on flood wall because of high moisture content. Soft material is stripped and backfilled with select borrow to assure firm base for levee. Equipment on job includes new Euclid VB Loader and new Allis-Chalmers HD-19 torque converter tractor, loading 16 cu yd of dirt every 30 seconds.

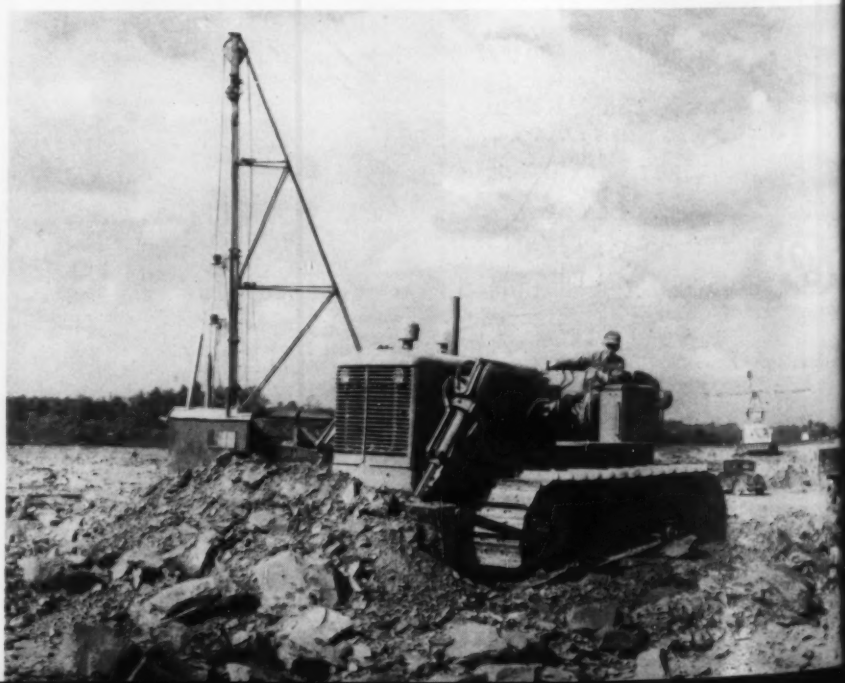
A CONTRACTOR or public body working a job has two primary items of cost: (1) Job expenses; and (2) cost of owning and operating equipment. The contractor will earn or lose money on the job depending on the difference between his income and his costs. Once the bid has been made there is nothing he can do about money he will receive, but he can control his two main cost items, which in turn can increase or decrease his loss or earnings. In the case of public bodies, the degree of economic success realized is reflected by the savings to taxpayers resulting from a reduction of costs.

Equipment Purchase Involves Many Factors

Cost of owning and operating equipment is determined primarily by the type of equipment involved and the kind of jobs to be worked. For example, if a contractor is planning to buy equipment, he must consider such factors as initial cost, duration of job, length of hauls, quantity and nature of material to be moved, climate of operating area, and if possible, the type of future jobs he will handle. Equipment buyers should take advantage of the service facilities offered by dealers when considering a new purchase. Efficient, economic performance depends a great deal on the post-sale service of the dealer.

Obviously, there is no ultimate saving in the purchase of small lower-priced units if increased overhead, because of additional time on the job, absorbs the profit. On the other hand, it might not be wise for a contractor who operates on a small scale to tie up his capital in a single large unit. If the machine were made idle for some reason, or if the contractor did not have sufficient work to use the full capacity of the unit, he might suffer a financial loss. High-speed rubber-tired equipment may have certain advantages on long hauls, but if the roadway is rough or slippery, crawler tractor-scraper units should be available. Thus, there is an optimum balance between the type and scope of work performed and the equipment employed.

When the proper equipment has been selected, the problem resolves into one of laying out the work, ma-



MAINTENANCE OF HAUL ROADS is essential on construction jobs and is vital factor in efficient management of other industries such as logging and mining. On Maumee Colliery operations near Jasonville, Ind., HD-19 tractor equipped with Gar Wood bulldozer is used primarily on road work to facilitate work of large 1150-B Bucyrus-Erie dagline and 25-cu yd shovel. Tractor also maintains roads for trucks operating around mine, thus increasing productive capacity of all equipment on job.

rials and usage of machines to uarantee maximum production. onsideration of certain fundamental rinciples or factors will help promote n efficient operation schedule and ermit the working of machines at full apacity.

Check Mechanical Condition of Equipment

The mechanical condition of equipent should be carefully checked and l necessary repairs effected. During e current period of parts shortages, ontractors and municipal garages ould determine their equipment reair needs well in advance of the ctual time of overhaul. This prace not only aids equipment owners, ut provides the information needed o expedite deliveries from the factory o the dealer. Service men should be structed to make necessary adjustents and effect proper lubrication. rogressive manufacturers have esablished extensive service schools for ealer and customer mechanics. neumatic-tired units should be hecked for proper inflation. Operators should be advised regarding the mitations of their machines to help eep maintenance repairs at a minimum.

Service facilities should be arranged so that routine maintenance an be accomplished on the spot or long the travel route so that machines will not have to go out of their way to be serviced. Avoid traffic congestion that will tie up equipment.

Consideration should be given to the potentialities of rippers, pusher units, or other types of equipment in effecting capacity loading. Traffic patterns arranged to take full advantage of down-hill loading speed up the operation considerably, especially if the loading operation is in the direction of hauling.

Maximum Performance on Haul Routes

Every effort should be made to maintain the highest practical speed along haul routes. If road conditions are such as to slow up operations, the use of a grader or road maintainer might be practical. Frequently, self-loading scrapers can be employed to dress up high and low spots as they return empty. This expedient is used only when graders are not available.

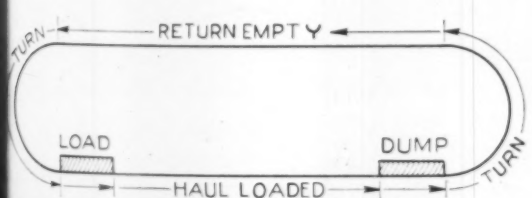
RIGHT EQUIPMENT ON JOB results in more loads per hour in constructing Billy Mitchell Field, Milwaukee's major airport which serves six commercial airlines, Army Air Forces and Wisconsin National Guard Aviation Unit. Expanding of field to 1,400 acres and reconstructing new 7,650-ft north-south runway involves moving $1^1/_4$ million cu yd of dirt. Equipment pictured is 20-ton HD-19 diesel recently announced by Allis-Chalmers as world's largest crawler tractor, and 25-cu yd Gar Wood scraper.

Time Studies Are Important

Time studies of complete cycles should be made periodically to determine where operations can be speeded up. Where many thousands of yards of earth are being moved the saving of a few seconds on each round trip may reduce the job time by many hours. An effective time study can be made by dividing the entire cycle into the following operations: (1) Load; (2) haul loaded; (3) dump; (4) turn after dump; (5) return empty; and (6) turn to load.

The time in minutes required to perform each of the above operations should be observed, and after a representative average of each operation has been obtained, a study of that particular operation will determine whether the time can be reduced. An operator attempting to load in too high a gear may be forced to stop and shift to a lower gear, or perhaps hauling is being done in too low a gear. The speed of travel, usually an important item, should be observed. Determination of the number of cubic yards of dirt carried in the average pay load and the number of trips made per hour are vital checks in obtaining the production rate in cubic yards per hour. This information will permit a comparison of the performance of various units on the job.

Overhead costs on a job remain relatively constant regardless of the dirt-moving units used, and the cost per hour for owning and operating various similar units which differ only in size is sufficiently small so that the deciding factor as to the best machine is the production rate in yards per hour. The primary objective for increased earnings therefore lies in increased production. For example, if a tractor-scraper unit making ten trips per hour reduces its trip time by one minute, the number of trips is increased by two per hour, an increase in production of about 16 trips per eight-hour day.



EFFICIENT TRAFFIC PATTERN takes advantage of down-hill loading to speed up operation. Diagram shows simple haul cycle for tractor-scraper unit.

"Money-Losing" Factors

Time studies made in the field on actual jobs show that the following items are among the primary "money-losing" factors:

1. Waiting for fueling and lubrication.
2. Waiting to load.
3. The wrong equipment for the job.
4. Abusive or improper use by operator, resulting in excessive repairs.
5. Lack of routine policy for servicing and making minor adjustments. (Should be done at a time when machine is normally idle.)
6. Poor haul road.

Earthmoving machines of today have not reached their maximum development, but they have however reached a point where the intelligent application of present-day models goes a long way in effecting maximum performance.

INVESTMENT IN FORMS, large item in concreting cost, is determined by required job speed and by concrete setting time. With high early strength portland cement, forms filled one day can be re-used the next. On large girder-and-slab structure illustrated, contractor reduced formed area by 40 to 60 percent by using each form set ten times. Forms filled one day were rolled into position the next, thus placing an acre a day under roof.

Two Decades of Service

Prove Structural Soundness of High Early Strength Cement

SINCE THE INTRODUCTION of high early strength portland cement in this country in 1927, designers and builders have developed techniques which permit the placing of concrete one day and the use of it the next. On this twentieth anniversary there is timely interest in a reappraisal of the attributes of fast-hardening concrete in expediting the building of many types of structures, and in the performance record based on inspection of many structures some of which have seen two decades of service.

THE BASIC DIFFERENCE in performance between high early strength cement and regular portland cement is that the former, through refinements in manufacture, produces service strengths in 24 hours instead of the week or more required for the older type. This increased rate of strength gain, while demanding no basic change in placement methods, has permitted far-reaching economies through more efficient job scheduling and form use. Fast-hardening concrete has become a year-round, ready-to-use construction material for buildings, hangars, bridges, tunnels, highways, reservoirs, flumes, precast piles, and a great variety of supplementary structures, some of which are shown in the accompanying illustrations.

FOR TWO DECADES high early strength portland cement has promoted the use of line production methods in the construction of concrete structures, a time- and labor-saving practice which has proved so effective in industry. Unproductive time spent in waiting for concrete to harden has been practically eliminated resulting in accelerated schedules that have meant savings in construction costs to owner and contractor alike.

When first introduced, high early strength cement was specified only for rush jobs such as in the Moffat Tunnel in the Rockies. Later, however, the many contributory advantages of saving time on many types of construction through the use of a fast-hardening concrete were realized, and the new building material was more widely specified. These advantages may be summarized under five main headings:

1. *Savings in form work* due to the need for fewer forms, amounting to as much as 60 percent in form material and labor.
2. *Benefits to industry and commerce*, which include savings of weeks in the completion of factories and plant additions; avoidance of plant

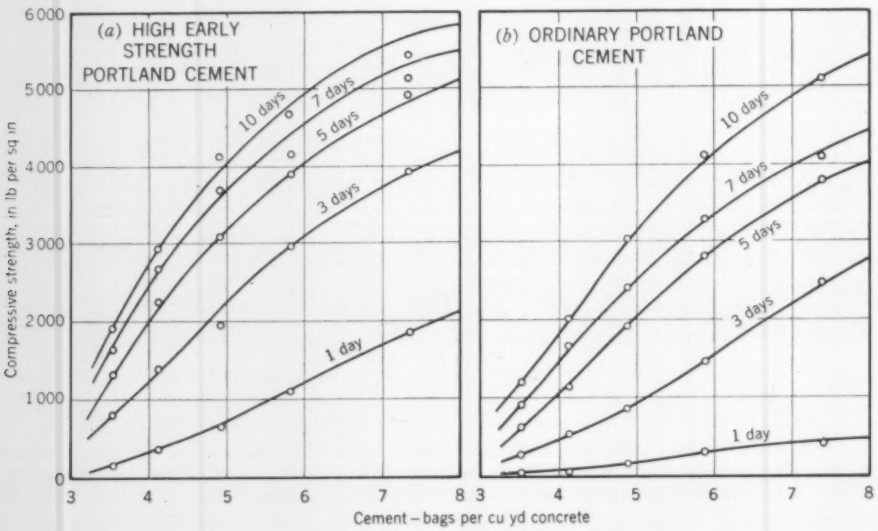


FIG. 1. COMPRESSION TESTS of 6 × 12-in. cylinders made and cured at 50 deg F show cement content–strength relation for high early strength and ordinary portland cement concrete. Each value represents average of four cylinders tested in laboratory. Test cylinders are machine-mixed concrete with sand-gravel aggregate. Water is proportioned to produce 3-in. slump.

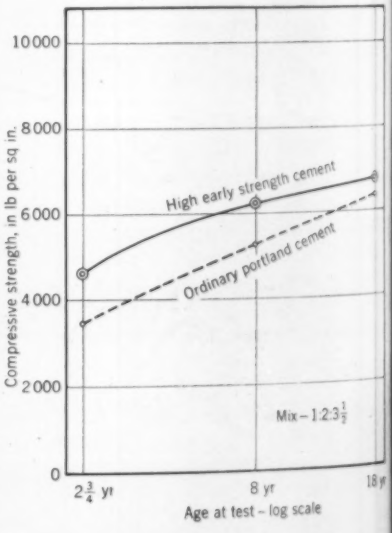
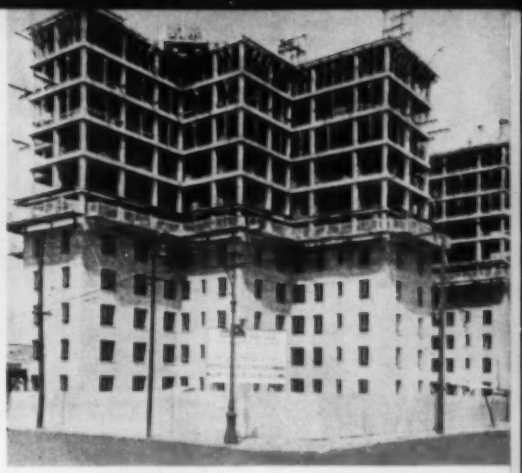


FIG. 2. TESTS OF CORES from Waltham, Mass., represent typical case history of high early strength cement concrete. Progressive gain in strength throughout 18 years' service in heavy traffic is recorded.

EFFECTIVENESS of straight-line methods in building construction is illustrated (above) by fast erection schedule made possible through use of high early strength cement. Speedy construction of concrete beam-and-girder factory building with 20-ft bays, covering entire block in Long Island City, N.Y., required forming of but 15 percent of area. Three times as many forms would be required for equal speed with ordinary methods. Thus two form sets (costing $10,880 at 1940 prices) were saved.



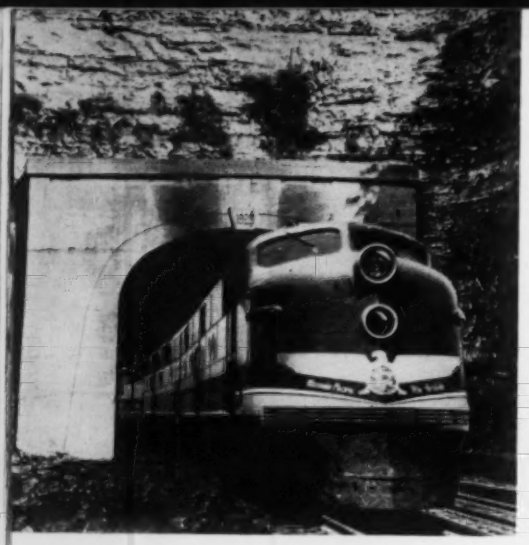
ERECTED IN 37 DAYS, 13-story reinforced concrete apartment building (above) sets speed record for modern fire-safe construction. Living space needed in hurry is thus obtained on New York Housing Authority project in Brooklyn, N.Y.

PRECAST CONCRETE PIPE AND PILING (above) of high early strength cement expedite production and increase plant efficiency. Concrete piles for Tampa, Fla., Union Terminal were lifted three days after casting and driven to refusal 24 hours later.

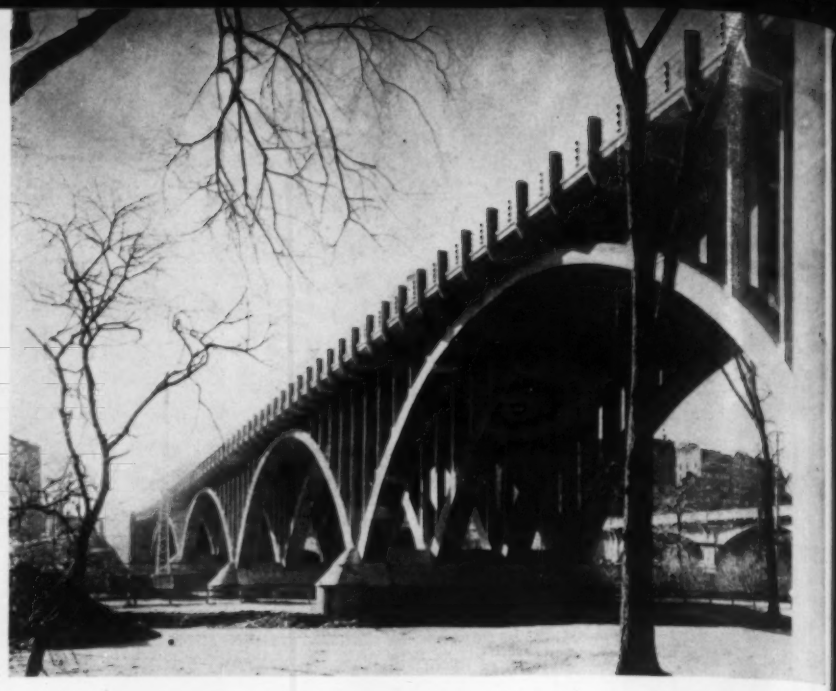
PRECAST REINFORCED CONCRETE SLABS (above) form floors for 110 garden-type apartment buildings for United Nations personnel at Jamaica, Long Island, N.Y. Slabs made with quick-setting cement, cast in 115 molds, are lifted day after pouring. Floor system, which averages only 2½ in. thick, including beams, slabs and girders, requires about half as much concrete as conventional construction.

RELIEF OF TRAFFIC CONGESTION at one of busiest spots in suburban New York (below) is obtained by widening Saw Mill River Parkway from four lanes to six, with center dividing strip, for distance of 2 miles from terminus of Henry Hudson Parkway to Cross County Parkway. Work is facilitated by use of 24-hour cement for closing-out paving, access lanes, gas-station approaches, and gaps left for drainage work.

INSPECTION OF UNDERPINNING work (below) done in 1928 to stop settlement of South Carolina Museum of Natural History shows building in fine condition. Use of high early strength portland cement decreased timber requirements by 75 percent and also reduced construction hazards by speeding up backfilling and cleaning up of job site.



MISSOURI PACIFIC TUNNEL, Gray Summit, Mo., constructed with high early strength portland cement in 1929, is in "excellent shape" with "no maintenance expense" according to engineers' report. Tunnel completion advanced date when double-track cutoff between St. Louis and Jefferson City could be placed in service, cutting expensive operating delays to minimum. Drilling operations were closely followed by lining. Single form section used was moved forward 12 to 24 hours after placing concrete.



MARKING TIME WHILE CONCRETE HARDENS is expensive pastime on high-cost improvements. Through use of 24-hour cement on Cross County Parkway Bridge at Fleetwood, N.Y., contractor saved thousands of dollars in forms, falsework and overhead by forming only one row of ribs and moving forms sideways. Experience on ribs led to use of same cement for deck, with further savings; also on roadway, where it was placed in cold weather and minimized freezing risk. Contract carrying $700-a-day penalty was finished two weeks ahead of time.

RELOCATION OF LINCOLN HIGHWAY east of Pittsburgh in 1930 required 600,000 cu yd of fill 120 ft high in narrow valley. Use of high early strength cement allowed contractor to start fill two days after concreting began, hastening completion by two months. Project is in fine condition today.

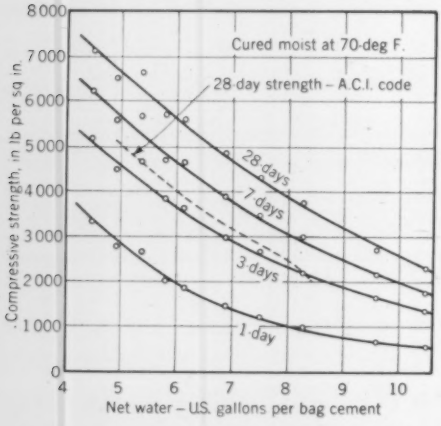


FIG. 3. CURVES SHOW typical water-cement ratio-strength relation of high early strength cement concrete at 1, 3, 7 and 28 days. Graph represents average of 1,200 6×12-in. cylinders made, cured and tested according to ASTM specifications.

tie-ups through rapid rebuilding of floors, driveways, machinery bases, etc.; reduction of slow-order movement during railroad construction and maintenance; and minimum disruption of traffic during street repaving.

3. *Time saving for the motoring public* due to elimination of much detouring and congestion during highway construction.

4. *Better curing resulting in stronger concrete*, because the short curing period permits better curing practices under average job conditions.

5. *Uninterrupted winter work* since with this type of cement, it is only necessary to maintain concrete at 60-70 deg F for 24 hours, after which period it is service strong and unharmed even by zero weather. Formerly the high cost of prolonged heat protection caused the shutdown of concreting operations in cold weather.

Tests Prove Strength and Durability

Since time alone can demonstrate the ultimate strength and durability of concrete, a number of 20-year-old pavement cores of high early strength cement concrete were recently tested. The tests were conducted by the Pittsburgh Testing Laboratories for the Lone Star Cement Corp., which introduced Incor, the first high early strength portland cement, in 1927. The cores tested came from the country's oldest pavement in which this type of cement was used—at Limedale, Ind.—and showed strengths of 7,800, 8,150, 7,790, 8,000 and 8,200 psi. Other core tests also showed a continuing strength gain after nearly 20 years of service. A condition survey was also made covering all types of projects, many of which had been in service for two decades. Graphs illustrating the characteristics of high early strength portland cement appear in Figs. 1, 2, 3 and 4.

An example of a structure on which savings were realized by the use of 24-hour-cement is the George Westinghouse Bridge, built in 1930–1931 to carry the Lincoln Highway 1,500 ft in five spans across Turtle Creek Valley

(*Continued on page 74*)

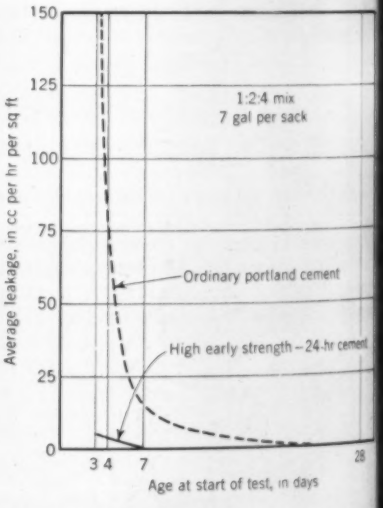


FIG. 4. EFFECTIVENESS of high early strength cement for watertight concrete after short curing periods is shown in tests of 6×2-in. disks under 80-psi water pressure. Disks were substantially watertight after 3 days as compared with about 10 for concrete made with ordinary portland cement.

Engineers' Notebook

Improved Technique Saves Time in Obtaining Undisturbed Chunk Samples of Clay

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WHEN UNDISTURBED clay samples are obtained by hand, the choice of cutting tools is important since the use of proper tools results in a considerable saving of time. In the soil testing course at Harvard University, students are required to obtain undisturbed clay samples from the pit of a local brick company. Removal of these samples with conventional clay spades and wire saws has been a time-consuming and back-breaking undertaking. To expedite the work, the writers developed a clay knife made by fastening a loop of soft steel, $^1/_{16} \times {}^3/_4 \times 8$ in., to a suitable wooden handle (Fig. 2). In principle, this knife is similar to the power-driven knives developed for tunneling in clay.

The purpose of such a clay knife is to cut narrow slots into a clay bank to a sufficient depth to permit a large wire saw to be used for cutting the

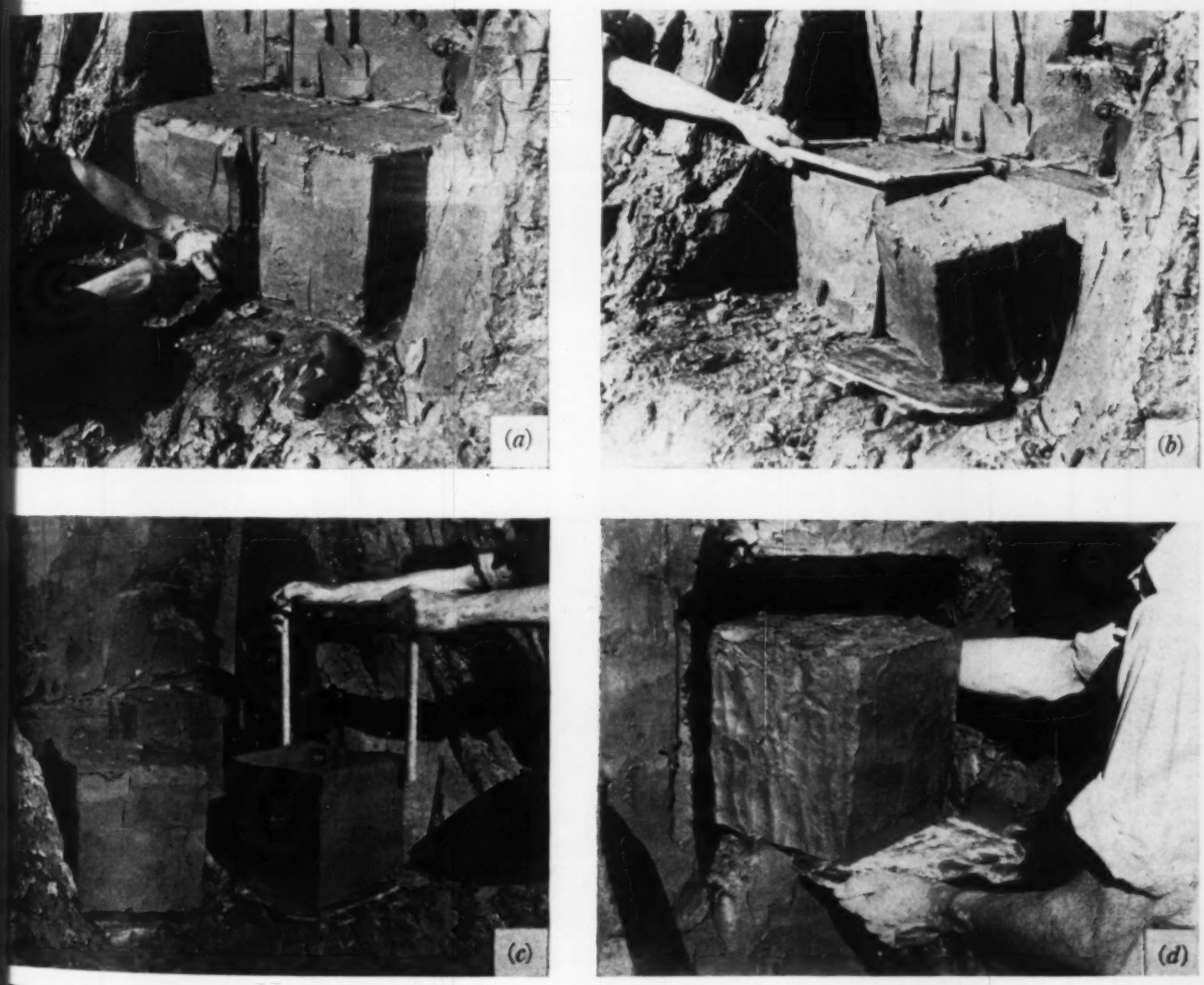

FIG. 1. STEPS IN OBTAINING UNDISTURBED SAMPLES of clay include: (*a*) Cutting vertical slots with specially designed clay knife; (*b*) cutting sample free with wire saw; and (*c*) final trimming and shaping of sample. In view (*d*) sample is removed from vertical face.

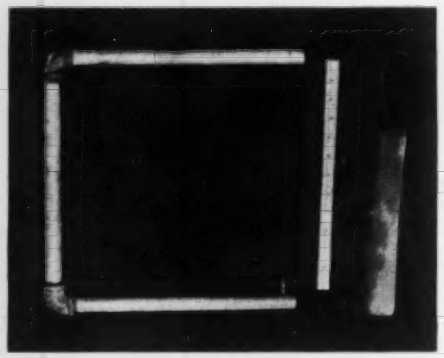

FIG. 2. IMPROVISED TOOLS for sampling clay include clay knife (right) made from loop of soft steel fastened to wooden handle; and wire saw made by stretching piano wire across pipe frame, dimensions of which are governed by size of samples to be obtained.

back and bottom of the sample. The dimensions of the frame of the wire saw depend on the size of sample to be obtained. The wire saw illustrated in Fig. 2, made by stretching a piano wire across the 12-in. open throat of a frame of $^1/_2$-in. galvanized iron pipe, was found satisfactory for cutting samples about 10 in. in width. For most clays piano wire No. 8 was found satisfactory. For stiff clays a heavier piano wire is recommended.

Sampling from an Inclined Face

After all the dried and disturbed material has been removed from the surface, a step is cut into the face of the slope with a clay spade. Then the clay knife is used, as shown in Fig. 1 (*a*), to cut vertical slots, about 3 in. wide, spaced to fit the wire saw. The clay knife, held firmly in a horizontal position, is moved downward. The clay "sausages" curl away from the bank and are easily removed. The sample is cut free by inserting the wire saw, Fig. 1 (*b*), which is first pulled down along the back of the sample and then forward along its bottom. The wire saw is used with a steady, continuous motion.

If the sample is difficult to dislodge, it may be loosened by inserting a shovel horizontally, slightly below the bottom cut, and gently prying upward and forward, following which it is slid out onto a flat board and trimmed and shaped with the wire saw as shown in Fig. 1 (*c*).

Sampling from a Vertical Face

When sampling from the vertical face of a cut or test pit, the clay knife is utilized to cut a 3-in. vertical slot on each side of the sample, and a 3-in. horizontal slot above it. The wire saw can then be inserted through the upper slot, pulled first downward to the bottom, then forward, and the sample removed as before. See Fig. 1 (*d*).

With minor variations in technique, the clay knife and wire saw can be used to obtain chunk samples from most fine-grained soils whose natural water contents are greater than their plastic limits. When stones, sand layers, or coarse silt layers are encountered, the wire saw cannot be used. Instead, the clay knife must be utilized also to cut the back and bottom of the sample, a much more time-consuming procedure.

Critical Collapsing Load for Columns of Variable Cross Section

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and R. V. BREMER

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IN 1941, when the U.S. Maritime Commission was preparing to increase greatly the production of ships for the Merchant Marine, one of the numerous structural problems considered was the design of tubular steel cargo-handling booms of variable cross section. An investigation was made and a report prepared—"Euler Critical Loads for Stepped Booms and Determination of Most Economical Proportions," by the authors. Since these results are applicable to any design of similar compression members, the pertinent data are here presented for more general use.

IN THE *Theory of Elastic Stability*, Timoshenko gives the theoretical development of the critical collapsing load (P_{cr}) of a column constructed of a mid-section and two smaller end sections. He shows that the critical load of such a column may be expressed by the equation:

$$P_{cr} = \frac{mEI_2}{l^2}. \quad . \quad . \quad . \quad (1)$$

in which I_2 is the moment of inertia of the mid-section, and l is the total length of the column. The value of the dimensionless coefficient m is determined from the following transcendental equation[1]:

$$\tan\left(\frac{l-a}{2l}\sqrt{\frac{mI_2}{I_1}}\right)\tan\left(\frac{a}{2l}\sqrt{m}\right) = \sqrt{\frac{I_2}{I_1}}. \quad (2)$$

In this equation, I_1 is the moment of inertia of the end sections, and a is the length of the mid-section.

[1] Equation 2 is a rearrangement of Timoshenko's Equation (*b*), page 130, *Theory of Elastic Stability*, to make it apply to symmetrical columns hinged at the ends.

Since Eq. 2 cannot be solved for m in terms of the other quantities, it is necessary to resort to a table of values

TABLE I. VALUE OF m FOR USE IN CALCULATING CRITICAL COLLAPSING LOAD (P_{cr}) OF THREE-SECTION COLUMNS

I_2/I_1	a/l .2	.3	.4	.5	.6	.7	.8	.85	1.0
.2	2.80	3.43	4.22	5.31	6.89	8.19	9.33	9.65	π^2
.3	3.99	4.64	5.61	6.70	7.84	8.87	9.58	9.74	π^2
.4	5.08	5.76	6.68	7.61	8.51	9.25	9.67	9.79	π^2
.5	6.07	6.74	7.51	8.27	8.93	9.46	9.73	9.81	π^2
.6	6.98	7.57	8.19	8.77	9.24	9.61	9.78	9.83	π^2
.7	7.81	8.29	8.74	9.15	9.48	9.70	9.81	9.84	π^2
.8	8.55	8.90	9.18	9.45	9.63	9.76	9.84	9.85	π^2
.9	9.24	9.43	9.56	9.69	9.76	9.82	9.85	9.86	π^2
1.0	π^2	π^2	π^2	π^2	π^2	π^2	π^2	π^2	π^2

$$P_{CR} = \frac{m E I_1}{l^2}$$

NOTE
INTERMEDIATE VALUES OF 'm' TO BE OBTAINED BY INTERPOLATION.

of m, calculated for specific ratios of a/l and I_1/I_3. Such values are given in Table I. The table is the same as that given by Timoshenko except that the range has been extended and intermediate values added. By use of the table and Eq. 1, the critical load of any three-section column can be easily calculated.

The determination of the critical load for columns of more than three sections becomes somewhat more cumbersome on account of the increase in the number of variables involved. In a manner which is the same mathematically as was used to determine Eqs. 1 and 2, it can be shown that the critical load of a five-section column, as before, may be written,

$$P_{cr} = \frac{mEI_3}{l^2} \quad . \quad . \quad .(3)$$

in which I_3 is the moment of inertia of the mid-section. The value of m for this case is determined from the equation:

$$\sqrt{\frac{I_3}{I_2}} - \tan\left(\frac{l_2}{l}\sqrt{m\frac{I_3}{I_2}}\right)\tan\left(\frac{a}{2l}\sqrt{m}\right) = \sqrt{\frac{I_3}{I_2}}\tan\left(\frac{l_2}{l}\sqrt{m\frac{I_3}{I_2}}\right) + \tan\left(\frac{a}{2l}\sqrt{m}\right)$$

$$\sqrt{\frac{I_1}{I_2}}\tan\left(\frac{l_1}{l}\sqrt{m\frac{I_3}{I_1}}\right) \quad . \quad .(4)$$

In this equation, I_1, I_2, l_1, and l_2 are the moments of inertia and lengths of end and intermediate sections, respectively, and a is again the length of the midsection.

Equation 4 is perfectly general and it may be used directly to determine m for any particular set of conditions. Its use in the determination of tabular values of m was found to be impracticable, however, because of the large amount of labor involved in the necessary trial-and-error method of solution. Variation in the length of the mid-section has an important effect on the critical load, but the latter is not particularly sensitive to moderate variation in the lengths of the end sections. Thus, for convenience, it was assumed that the four end sections were all of equal length, and the values

$$l_1 = l_2 = \frac{l - a}{4}$$

were substituted in Eq. 4.

On this basis, m values can be calculated by assuming a range of specific values for the ratios I_1/I_2, I_2/I_3, and a/l, as was done for the previous case. These data are presented in Table II. By the use of this table and Eq. 3, the critical load of a five-section column can be calculated as easily as before. Since a moderate variation in length of the end and intermediate sections has only slight effect on the critical load, the data may be used for all practicable arrangements. In extreme cases, the m value to be used should be calculated directly from Eq. 4.

It will be noted that the critical loads determined in this manner do not assume any particular shape for the various cross sections. It can be seen that critical loads of three- and five-section arrangements can be directly compared, and further that they may also be compared to columns of a single straight section, for in this case the Euler equation for critical load is:

$$P_{cr} = \frac{\pi^2 EI}{l^2} \quad . \quad . \quad .(5)$$

with an m value equal to π^2. This relationship is further clarified by an inspection of Tables 1 and 2, which show that as a change in proportions is made approaching a constant section, the m value approaches π^2.

Under these conditions, it is evidently possible to assume a particular shape of the cross section to be used, and then to determine the number of sections, the proportions of a to l, and ratios of the moments of inertia, which will result in the highest value of the critical load per pound weight for the column. For any particular design, possibly the best method would be to calculate the critical load per pound of a series of possible combinations and to make a choice among them.

As tubular construction is very often used for compression members, a detailed analysis to determine optimum proportions was made. The analysis indicates that best conditions are obtained with the approximate ratios listed below:

	Number of Sections	
	Three	Five
Ratio of mid-length to total length (a/l)	0.8	0.7
Ratio of end to middle moments of inertia	0.3	0.2
Ratio of intermediate to middle moments of inertia	...	0.6
Percentage gain of P_{cr}/W over that of single section	6.8	8.0

These results indicate that for tubular columns a rather high ratio of mid-length to total length should be used, coupled with a low ratio of end moment of inertia to middle moment of inertia. (In choosing the end section, a check should be made to ensure that the direct stress on that section does not exceed the allowable compressive stress of the material.)

In general, with regard to multiple-section columns, it appears that by careful proportioning, a weight saving of from 6 to 8 percent may be realized without loss in strength.

TABLE II. VALUES OF m FOR USE IN CALCULATING THE CRITICAL COLLAPSING LOAD (P_{cr}) OF FIVE-SECTION COLUMNS

I_1/I_3 = .2

I_2/I_3	.3	.4	.5	.6	.7	.8	.9
a/l = .3	4.37	5.18	5.78	6.26	6.65	6.97	7.22
a/l = .4	5.32	6.10	6.69	7.14	7.49	7.76	7.99
a/l = .5	6.37	7.14	7.65	8.03	8.31	8.53	8.71
a/l = .6	7.65	8.20	8.56	8.81	8.99	9.13	9.25
a/l = .7	8.79	9.08	9.27	9.39	9.48	9.54	9.60

I_1/I_3 = .3

I_2/I_3	.3	.4	.5	.6	.7	.8	.9
a/l = .3	4.64	5.39	6.32	6.89	7.37	7.78	8.11
a/l = .4	5.61	6.46	7.15	7.65	8.05	8.38	8.64
a/l = .5	6.70	7.44	7.97	8.37	8.69	8.93	9.13
a/l = .6	7.84	8.41	8.79	9.04	9.22	9.36	9.47
a/l = .7	8.87	9.19	9.37	9.48	9.57	9.65	9.70

I_1/I_3 = .4

I_2/I_3	.3	.4	.5	.6	.7	.8	.9
a/l = .3	5.76	6.55	7.21	7.75	8.19	8.58	
a/l = .4	6.68	7.36	7.92	7.34	7.70	7.98	
a/l = .5	7.61	8.14	8.56	8.89	9.14	9.34	
a/l = .6	8.51	8.99	9.14	9.33	9.46	9.57	
a/l = .7	9.25	9.42	9.54	9.63	9.69	9.74	

I_1/I_3 = .5

I_2/I_3	.3	.4	.5	.6	.7	.8	.9
a/l = .3	6.74	7.41	7.98	8.47	8.88		
a/l = .4	7.51	8.07	8.53	8.89	9.19		
a/l = .5	8.27	8.68	9.01	9.26	9.47		
a/l = .6	8.93	9.20	9.39	9.54	9.64		
a/l = .7	9.46	9.57	9.66	9.72	9.78		

I_1/I_3 = .6

I_2/I_3	.3	.4	.5	.6	.7	.8	.9
a/l = .3	7.57	8.19	8.69	9.11			
a/l = .4	8.19	8.64	9.01	9.32			
a/l = .5	8.77	9.10	9.36	9.56			
a/l = .6	9.24	9.44	9.57	9.68			
a/l = .7	9.60	9.67	9.74	9.79			

I_1/I_3 = .7

I_2/I_3	.3	.4	.5	.6	.7	.8	.9
a/l = .3	8.29	8.79	9.22				
a/l = .4	8.74	9.18	9.41				
a/l = .5	9.15	9.40	9.61				
a/l = .6	9.48	9.61	9.72				
a/l = .7	9.70	9.75	9.80				

I_1/I_3 = .8

I_2/I_3	.3	.4	.5	.6	.7	.8	.9
a/l = .3						8.90	9.34
a/l = .4						9.18	9.47
a/l = .5						9.45	9.64
a/l = .6						9.63	9.75
a/l = .7						9.76	9.81

I_1/I_3 = .9

I_2/I_3	.3	.4	.5	.6	.7	.8	.9
a/l = .3							9.43
a/l = .4							9.56
a/l = .5							9.69
a/l = .6							9.76
a/l = .7							9.82

$$P_{CR} = \frac{m E I_3}{l^2}$$

NOTES

1. INTERMEDIATE VALUES OF "m" TO BE OBTAINED BY INTERPOLATION.
2. LENGTHS OF END SECTIONS ASSUMED TO BE EQUAL, VARIATION IN THESE LENGTHS WILL HAVE ONLY SLIGHT EFFECT ON P_{CR}.

...THE READERS Write

Says Engineers Must Establish New Professional Standards

DEAR SIR: Perhaps some of the ills of the civil engineering profession may be traced to the efforts made to cure them. This reaction comes from reading the excellent analysis of the EJC report by John Girand in the January issue of CIVIL ENGINEERING. Two features of that analysis need careful consideration. The first is the thesis that increased education leads to increased earning power. The second is the attitude that administration must, of necessity, be separate from engineering.

In most of the fields erved by civil engineers, there is a tend ncy to regard the man with graduate training as a theorist, or at least as a specialist, and thus, one who can never hope to advance to the more highly paid administrative jobs. With this attitude, the educational treatment as a cure for the economic paralysis of the engineer may defeat its own end. There is some reason for such an attitude. Not only does the average engineering school underemphasize business and management training, but there are limitations on the facilities of the schools themselves. While patients can be brought into the medical schools and pilot plants can be set up in chemical laboratories, it is impossible to bring bridges, highways and dams into the engineering classroom. Therefore, the civil engineer must obtain a large part of his training on the job

It is often said that the lack of social and cultural training of the engineer handicaps him in advancing to positions of authority. Such development cannot be attained by measured doses of education in speech or "the humanities." Culture, like religion, is a state of mind induced by years of proper associations and gradual training. Two or more years of general college work prior to professional training would accomplish much in this regard, particularly in allowing the potential engineer time to benefit from campus activities and associations which the grind of the average engineering school curriculum does not permit. This is the system followed by schools of medicine and law. Its drawback in civil engineering is that nobody wants to go to college six or eight years to prepare himself for the low-salaried jobs generally available in the profession.

Hence, before education can contribute its greatest potential, the profession must offer greater rewards. This is in line with the development of medical and legal education. In these fields, earning power increased first, and higher educational standards followed.

This brings up the second feature of the EJC analysis. There is a tendency, even among engineers, to consider administrative jobs as non-engineering functions. This is not in accord with the meaning of the verb "to engineer," which Webster defines as "to plan and manage..." It is not in accord with the history of management technique, which was largely developed by engineers. It is not in accord with the requirements of modern industry, where more executives have engineering training than any other. In governmental agencies (which are not noted for efficient management) we do not see many executives with engineering training. Yet here we find nearly half of our civil engineers.

In recent years, a number of "professions" have sprung up which tend to appropriate the management functions of engineering. Like the galaxy of chiropractors, naturopaths, and others practicing the healing arts on the basis of superficial training, a horde of clerks and graduates of "snap" college courses have set themselves up as judges of policy and personnel in dominantly engineering organizations.

To increase the earning power of civil engineers, it is necessary to go after these administrative jobs, wherever the superiority of engineering training can be demonstrated. Standards must be set up to distinguish the engineer from the technician on the one hand and from the scientist on the other. It is necessary to recognize that the essence of engineering is use of judgment in planning and management of certain definite activities.

The American Society of Civil Engineers can, with profit, study the methods used by the American Medical Association in outlawing quacks, in distinguishing between practitioners and technicians, in insisting on definite standards to obtain recognition, and in making its recognition virtually mandatory. Under such a policy, the quality of medical skill in this country has progressively improved.

When a system of accrediting engineering work is installed similar to that used in accrediting colleges, the latter will be in a position to contribute more to the advancement of the profession.

F. H. KELLOGG, M. ASCE
Head, Dept. of Civil Eng., University of Mississippi
University, Miss.

Information on Professional Engineering Law Available

TO THE EDITOR: Members of the Society who are interested in practice as consulting engineers may be glad to have data on states that prohibit professional engineering by corporations.

The outstanding example is New York State for engineering corporations organized subsequent to 1935. Other states with similar provisions in various degree are Rhode Island, Connecticut, Pennsylvania, Ohio, South Dakota, Idaho, and Washington.

Some states such as South Carolina have an ambiguous requirement in this regard.

The National Council of State Boards of Engineering Examiners, Post Office Drawer 1404, Columbia, S.C., publishes at cost for $2 a digest of the laws of the various states as to professional engineering.

These data were obtained through a lawyer, the National Society of Professional Engineers, and the National Council for State Boards of Engineering Examiners.

GREGORY M. DEXTER, M. ASME
New York, N.Y.

Need for Research in Concrete Mixes Is Stated

TO THE EDITOR: In the article, "Grouted Gravel Fill and Precast Slabs Provide New Face for Barker Dam," by Messrs. Davis, Jansen, and Neelands in the February issue, it is stated that "Alfesil, which is the trade name for a very finely divided siliceous material, was employed in all grout mixes..." and that it "possesses the property of combining with calcium hydroxide liberated

during the process of hydration of the cement and therefore contributes to watertightness and long-continued gain in strength."

The writer believes that an admixture of finely divided siliceous material, either chemically active or inert, may indeed be beneficial to concrete in many cases. As for combining with free lime it is his recollection that the cement for Bonneville Dam was especially designed to meet all of the peculiarly exacting conditions that prevailed in that structure, whatever they were. Its specification called for the intergrinding with the cement clinker of an activated silica which would combine with the free lime released by the hydration of the cement to form calcium silicate, an insoluble compound that filled voids and contributed to the gain in strength. A casual consequence of the specification was the elimination from the work of Washington and Oregon cement whose mills either could not, or thought they could not, manufacture this pozzolanic cement.

A few years ago the writer had the opportunity to inspect Bonneville Dam and found its concrete to be in excellent condition. Its inspection gallery, however, revealed a certain number of fine cracks and leaks, at which appeared the familiar white calcium deposit and incrustation that characterizes surfaces on which water that has worked its way through the concrete has evaporated. Also there were a few scattered small stalactites of the same material on the roof of the gallery, and in the marginal gutter there was a lining and incrustation of it.

From this it can be concluded either that there is need for broader and more extensive research and investigation, or that "tis but a patch on beauty's check" and inconsequential, anyway. Ross Dam on the Skagit River, in Washington, with a very well-graded sound aggregate, 4 sacks of Type II cement per cubic yard, with 0.6 percent maximum alkali limitation but without special research or finely divided silica, is producing concrete of the very highest strength and quality.

HOMER M. HADLEY, M. ASCE
Consulting Engineer
Seattle, Wash.

Closes Discussion on Angle Trisection by Graphical Methods

TO THE EDITOR: To supplement my article, "Angle Trisected by Graphical Methods," in the January issue of CIVIL ENGINEERING, I should like to suggest a third method of angle trisection. Comments on the methods presented by several discussers of my article will also be given.

Assuming that the angle to be trisected is α, bisect α and on each side and equidistant from the bisector draw parallel lines B and C. At any random radius AD draw arc DE, cutting lines B and C at F and G. Join F and G. With center F and distance or radius FG, inscribe an arc cutting DE at 1, and with center G and radius GF inscribe arc cutting DE at $1'$. Join F and 1, and G and $1'$. The three equal chords $1F$, FG and $G1'$ subtend equal angles and trisect the angle $1A1'$, which of course is not the angle submitted. Also the process is the reverse of that required in trisecting a given angle. In the first place, the chords are established and the angle fitted to it, while in the latter case, the angle is given and the chords are to be found.

In several other cases, arcs are established with center at A, and the points 1, 2, 3, 4, 5 and 6 are found. It is evident that an infinite number of arcs are possible, but the few points shown indicate that the controlling line passing through the point is remarkably coincident with a straight line. It is apparent that with small angles up to the angle shown, the controlling line would be almost straight.

In view of the foregoing, it would only be necessary to use *two* arcs, one on each side of the point P, and the approximate position of P for this purpose may be found by a line parallel to B and C at a distance slightly less than B to C. A line joining points 4 and 5 intersects the leg of the angle at point P.

With center at A and radius AP inscribe the arc $PQRS$, cutting lines B and C at Q and R, respectively, and the other leg of angle α at S. Join PQ, GR and RS, and these three chords subtending equal sections of the angle α provide the trisection. In order to keep the point P in the range where the intersection of the leg of the angle with the controlling line is more precise, it may by desirable to add some factor (or multiple) of 22 deg 30 min to small angles and after trisection, take away a third of the factor (or multiple) used from the trisection. Any factor or multiple of 22 deg 30 min may be obtained by bisections of 60- and 90-deg angles—that is, angles in an equilateral or right-angle triangle. For larger angles over, say 60 deg, subtract a factor or multiple of 22 deg 30 min and, after trisection, add a third of the factor or multiple to the trisections. The foregoing method of trisecting an angle appears unusually simple and essentially correct, since it is only necessary to use two arcs, one on each side of the point P, to establish that point, which fixes the starting point for intersection.

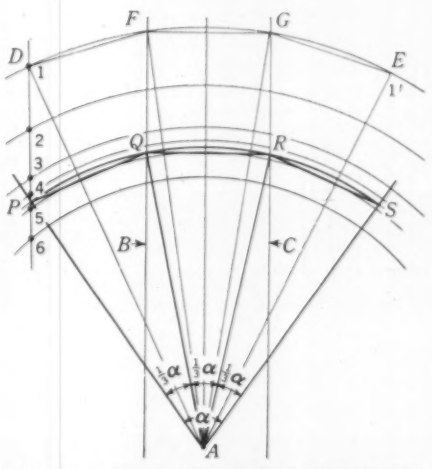

FIG. 1. SHOWS ANOTHER GRAPHICAL method of angle trisection.

Closing Comments

In presenting the three methods of trisection of an angle by graphical means, I have strictly adhered to the use of compass and unmarked straightedge. It will be noted in Fig. 1, in my article in the January issue, that I have used a pair of dividers to transfer one length from one plot to another, but since the angle was already trisected it should have no bearing. Moreover, it is not necessary in any case, for by establishing the points x, y and z below the base line of the angle, it is left in its original position. A well-known encyclopedia definitely says that an angle is impossible of trisection under restriction to the use of compass and unmarked straightedge only. My only claim is that it may be done with an accuracy equal to that obtainable in any problem of Euclid, limited by the skill of the best draftsman.

Mr. O'Farrell presents a rather ingenious method by using a subsidiary equilateral triangle and, apparently, an arbitrary radius of $1^1/_3$ times the chord. I have computed a trisection by this method, using seven place logs, and it gives a remarkably close approximation well under 1 percent. However, this method has one characteristic in common with the others presented, in that a length or distance is transferred by scale or otherwise from one place to another so that they do not conform to the restriction noted above.

The methods given by Messrs. Bergman, Jordan and Ramirez have also a common element in that they fit a selected length by trial series, into such a position (not previously established) that, if correctly done, would trisect the angle, but these again are not embodied in any problem in Euclid covered by restrictions of compass and unmarked straightedge.

In the three methods I have presented, there is one common characteristic—that is, the intersection of the arc of the angle to be trisected as with a flat curve, between two points, which may be infinitely close together but for visual production so close that a straight line joining them differs so little from the curve that even theoretically it may be considered exact since, for very small angles, the arc, sine, and tangent are straight lines.

In my first method, I have given an equation to establish the direction for the radius A_1X for the quarter point. However, this is not necessary and was only given to make the process easier to follow. By subdividing into four equal parts, the quarter of the arc of the angle with radius four, it is evident that three parts represent the change in a negative direction and four parts in the positive, so that by extending the long arc to one of these subdivisions α, joining that with the center D, and drawing a parallel line through A_1, it establishes the point X.

JAMES B. GOODWIN, M. ASCE
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Freeman Traveling Fellow Reports on European Harbor Installations

Lt. Col. George F. Dixon, Jun. ASCE, who as the Society's first postwar Freeman Fellow is making a study of European installations to maintain harbor channel depths by induced scouring, has submitted a report on the first months of his work. United States harbor channels require $25,000,000 of dredging work annually by the Corps of Engineers, and Colonel Dixon's project involves a study of possible savings that may be effected. Excerpts from his report follow.

I WILL REPORT a few of the more interesting attempts that I have seen to reduce the silting up of harbors. Naturally, a big part of the solution to this problem is the proper location of breakwaters, jetties, and training walls.... To bring out the complicated nature of this [proper location], I briefly cite the case of the breakwater at Zeebrugge, Belgium.... The seawall, which was built from 1900–1908, in effect also serves as the wharf for ships. It is some 3 km long and 80 m in width...and was built with an opening, a *claire-voie*, 300 m long. After construction and due to conditions inaccurately known at the time, the harbor began to lose depth and dredging had to be resorted to....

George F. Dixon

In 1936 the problem was studied by Professor Thijsse at Delft by means of a model. The problem was given to him with the seawall closed. His solution was the filling in of part of the harbor.... Later the problem was given to Mr. Lamoen, of the Antwerp Laboratory, who made movable bed models of the harbor and conducted numerous tests. The condition of the closed *claire-voie* was removed this time, however. Mr. Lamoen's recommendation...was to construct the "Delft fill" and, in addition, build an island..., the *claire-voie* being left open. The model tests indicate that such a solution will maintain the depths along the seawall—the berth for large ships—and in the vicinity of the entrance to the canal to Brugge. The suggested construction would cost approximately $30,000,000 and would save about $270,000 annually in dredging. A final decision has not been reached by the Belgian government as to whether to go ahead with the construction or not.

A different approach has been attempted in the small harbor of Terschelling on the Island of Terschelling, which is one of the string of islands separated from the mainland of the Netherlands by the Walden Sea. This harbor comprises a channel with three docks, which connects with the so-called "Oostelijk Ras," a shallow basin enclosed with a stone dam.

During flood-tide the seawater streams through the harbor gully and into the "Oostelijk Ras." During ebb-tide the channel is flushed out. By this means the tidal prism is materially increased. During a normal tide approximately 700,000 cu m of water streams through the restricted harbor channel giving rise to maximum stream velocities of 0.45 m per sec during flood and 50 m per sec during eqb. These velocities are effective in keeping the silt moving through the channel.... As a result dredging is reduced, in the opinion of the harbor engineer, by 60 percent.

The effectiveness of the "Oostelijk Ras" is gradually being reduced because it is filling with silt. Its bottom level is now 99 m above normal low water, and this where the normal tidal range is only 1.70 m. But such is the problem with flushing basins, the dredging still has to be done, but with the advantage that it need not be continuous or in the harbor channel where it would interfere with traffic.

Blankenburg is a small fishing harbor on the northern shore of Belgium about 2 miles west of Zeebrugge. It was of interest to me because of the success of the flushing basin in eliminating all dredging in the harbor channel. The artificial basin itself is separated from the harbor channel by sluice gates. These gates are mounted on vertical axes in such a way that they can be manually tripped quickly at low water and when the basin is full to give a very sudden flushing action to the channel. The basin is allowed to fill during very high tide (on the average of about five times a month). The gates are then closed and the water retained until very low tide when the gates are suddenly opened. By so timing the opening and closing of the sluice gates, it is possible for the harbor engineer to get as much as 5 m of head in the basin. During the 15 min. it takes to flush out the harbor channel, the current velocities are extremely high and navigation is not permitted....

The naval base of Den Holder is located on the northern tip of North Holland—near the entrance to the Zuider Zee. This harbor channel has been maintained without resorting to dredging by utilizing the tidal prism to scour out the channel. This tidal prism is effectively increased by means of a jetty.... During ebb-tide the velocity of current through the harbor channel has been great enough so that from 1843 (first records after the construction of the works) until 1914 the depth of the harbor channel increased. From 1914 to 1932 the depth held constant. Since 1932, because of the closing of the Zuider Zee by the great dike from North Holland to Friesland, the channel has been gradually losing depth and dredging is now required....

Need for Trained Traffic Engineering Staff Cited

TO THE EDITOR: "Traffic Improvements Through Traffic Engineering," title of an article by Wilbur S. Smith in the March issue, is a misnomer. A more appropriate title might be "Is Traffic Engineering, Engineering and a Cure for Congestion?" The answer would be "Yes" and "No," depending upon one's definition of traffic engineering.

Professor Smith includes highway planning, economics, design, construction, maintenance, regulation, administration and something termed "control characteristics." Yet he limits his concept of *traffic* to private automobiles and a casual mention of pedestrians, forgetting over 20 billion transit passengers and tens of millions of tons of merchandise moved over public ways.

I think engineers will agree that while certain remedies will relieve the pain and discomfort of the common cold, they are no more a "cure" for it than are Professor

Smith's traffic palliatives the "cure" for congestion or accidents.

City engineers, police and school personnel are to be congratulated on their accomplishments to date with one-way streets, traffic signs, signals and markings, curb parking prohibitions, controlled turns, by-pass routes for through traffic, redesigned intersections and other street changes, selective enforcement and the promotion of safe public traffic habits.

These are welcome traffic improvements by whatever label they are achieved—Traffic Engineering, Enforcement or Education.

What cities need to make greater traffic improvement is a higher traffic CQ and TQ. All cities large and small have a CQ deficiency—that is, an insufficient civic "coordination quotient"; and fundamental requirement number one is to coordinate the views of business leaders and public officials on sound and suitable measures for expediting the movement of its people and goods. Civic cooperation and mutual understanding of each other's problems and responsibilities are a must for traffic improvements.

Most cities do not have full-time, permanent staffs of trained and experienced traffic personnel, and naturally their traffic TQ, or "Technical Know-How," is low.

A city can, however, secure competent and experienced traffic advisers who will provide a start-to-finish or sustained service aimed to raise the TQ by acting as coaches to city engineers, police, planning and educational authorities, while working on specific problems and organizing civic agencies for traffic action.

LESLIE WILLIAMS, Assoc. M. ASCE
Traffic and Planning Engineer
New York, N.Y.

Summer Survey Camp in Civil Engineering Education Held Important Career Asset

TO THE EDITOR: The summer survey camp when properly administered and preceded by preparatory instruction on the campus can continue to be a significant element in the training of the civil engineer. It offers wide opportunities for the training of young manhood both in the amenities of good living as well as in the art of surveying. Because in no other academic course will failure to accomplish creditably be more obvious to the student, the camp program hastens the development of initiative and resourcefulness and encourages the logical pursuit of a problem to its successful conclusion.

While in many institutions there has been a progressive abridgment in the scope of the academic program, such selective abbreviation is not necessarily undesirable. No reason exists, however, for humbling the teaching of the basic subject of surveying in the civil engineering curriculum by engaging the least-experienced personnel and having them instruct the youngest students. Sound surveying instruction has been crippled by the general unwillingness to hire capable teachers at higher wages and to support a personnel up-grading program at those large schools where many instructors are needed and where relatively little opportunity is afforded to advance.

Although great educational value attached to the camp as long as its program provided the student a chance to practice on a large scale the principles with which he had become acquainted in his campus courses, under the impact of increased demands of other courses in the civil engineering curriculum, surveying has taken a severe buffeting and progressive curtailment of instruction has taken place. Today curricula building in engineering is concentrated more and more around the physical sciences and engineering principles with less time devoted to details of engineering processes.

While few courses in civil engineering are of more immediate usefulness to the undergraduate or graduate than surveying, its utility is not limited to this group. Not only mechanical and electrical engineers, but engineers in all branches of the profession encounter experiences when they will find it necessary to review the broad outlines of some proposed project as depicted on a map, to read a property description, or to perform sundry tasks which will be made easier if a perspective, at least, of surveying principles and practices has been acquired.

Currently one application of surveying knowledge that is of particular importance is its use in the conduct of modern warfare. While a large body of necessary technicians can be rapidly trained, a nucleus of capable administrators and a field of candidates of broad technical training from which additional required numbers of supervisors can be obtained are necessary. High organizational effort as well as technical competency of the highest degree are imperative for the coordination of work of all air, sea, and land surveying groups.

To a large and ever-increasing extent, the sole justification for the summer survey camp in civil engineering education is the promise of solid benefits that are to be obtained over and above the loss to be sustained by the student as a result of his not being available for employment during this period. The chief purpose of the camp, therefore, is to provide genuine practice in the execution of large-scale, professional engineering surveys, together with the opportunity to lead party operations so that a degree of managerial ability or administrative competency is developed. While it is difficult to justify the expenditure of even a few days' time in such exercises as geodetic and hydrographic surveying whose professional practice absorbs but a very small percentage of graduates, it is highly worth while to present opportunities to plan party operations, to select suitable working procedures consistent with the teachings of the classroom and common sense, and to employ good judgment in the delegation of duties to members of the party and diplomacy and tact in coordinating all efforts. Granting such ideas are implanted, there will be stimulated a desire to produce at a reasonable speed a fair amount of satisfactory work each day. Good habits of carefulness, system, logic, and prompt decision are thereby formed.

A vigorous and progressive program that not only requires the extended efforts of all students but also grants them a high degree of freedom in carrying out their work is highly desirable. Nothing impairs the teaching process more than the elbow type of surveillance as practiced by some well-meaning instructors. Effective use of time can be promoted by the practice of distributing mimeographed assignments to the various parties each day and in advance of the time when they will be needed. Carrying lunch into the field when operations become extended will eliminate the wanton loss of time incurred by a return to the dining hall at noon. The quality of instruction can be strengthened by the temporary employment of key instructors of recent field and office experience. Preliminary campus instruction must be provided since camp is not the place to secure manipulative practice in the use of the transit, level, and tape. A camp failing to establish minimum entrance requirements must operate on an elementary level which is not tolerable, and a camp with an over-solicitous staff seeking to check and oversee every movement of the student-surveyor's time will fail ignobly to foster a spirit of independent work, will frustrate initiative, negate resourcefulness, and curtail speedy production of work.

Deletion of some of the work once considered vital to a camp curriculum and the streamlining of instruction must be accepted. Only through the most skillful management of fiscal policies, the exercise of the most discriminating judgment in the preparation of the academic program, and the expert introduction of character-building influences will the camp remain in the curriculum.

MILTON O. SCHMIDT, Assoc. M. ASCE
Urbana, Ill.

SOCIETY NEWS

EDITORIAL:

"Well, Young Man"

THOUGHT-PROVOKING, INDEED, is the following excerpt from a letter written by a Junior to the Headquarters Office:

"The title of 'Junior' seems to carry in the minds of many of the members the idea of being seen and not heard. . . . There seems to be no attitude of expression by the older members of 'well, young man, I'm glad you took engineering and joined our ranks, for we need new blood to make the Society grow in strength and power.' Instead, the Junior more or less gathers the idea he is among the great and established and it will be a long time before his work or interest is of any consequence to the Society. It seems to me that in a large degree the Junior finds himself in the position of a tolerated apprentice whose efforts could be of no aid to the Society, instead of being the pliable new addition whose efforts should be encouraged and guided and molded to make him a better engineer and citizen of his community."

Certainly the attitudes expressed are not those fostered by the Board of Direction. A large part of every Board meeting is devoted to the problems of the younger engineers and study of procedures by which the Society can serve them better and encourage them to contribute more to the Society and to the profession. The study of proposed membership grade changes, now nearing culmination, and the recent enfranchisement of Juniors, certainly attest to an interest in the younger civil engineer which the author of the letter apparently overlooked.

In any event, this frank and sincere statement affords a vivid demonstration of the fact that it behooves each member to undertake a critical examination of himself, and each Local Section to peruse the type and conduct of its activities, to find whether or not relations between older members and young men are what they should be.

The condition decried by this particular young man is not peculiar to engineering societies. Since people are as they are, there always is a likelihood of grouping of friends in organizational meetings, and a lack of inclination to extend appropriate welcome to newcomers or to enlist the services of just as many members as possible in the activities of the organization. This is not true in many Local Sections, where there is found a spirit of bubbling good fellowship and a genuine interest in the welfare of younger members.

Most young people are naturally somewhat hesitant to thrust themselves into the presence of older men. Perhaps they do not realize that the converse often is true. Rarely is an older man found who does not enjoy the company of young people, who does not have the desire to extend a kindly hand, and who does not feel complimented at being asked to advise and assist a younger man as opportunity may arise. But that older man also may be a little hesitant. He may wonder if he is presuming when he pushes himself into the presence of younger members. He may fear that they have in the back of their heads the question: "Where does this old-timer get off, telling us what's what?" Perhaps if both are a little less timid, they will be happily surprised at what happens.

Whatever the situation may be, the above quotation is well worth rereading and being made the subject of some serious thinking. No organization can go forward without sincerely encouraging its young members and making proper use of their talents.

Local Sections Studying Proposed District Changes

LOCAL SECTIONS of the ASCE are studying proposed changes in the Society's Districts and Zones, as recommended by the Committee on Districts and Zones. So extensive are the proposed changes from those in effect in 1947 that the Board of Direction felt the Local Sections should study them and voice the membership's desires to their respective Directors.

Since the study is expected to require most of this year, no changes in the boundaries are contemplated during 1948.

Copies of Economic Status Report Still Available

SOME 6,000 copies of "The Engineering Profession in Transition" have been sold through ASCE headquarters since this Engineers Joint Council report on the economic status of the engineer was issued late last summer. In addition to Society members, to whom the price is 50 cents per copy, many industrial firms and governmental subdivisions have ordered copies, non-members paying $1 each.

Engineers who have not yet obtained copies may do so through ASCE headquarters, where a small supply is still available.

Hydraulics Films Obtainable Through ASCE Committee

THE COMMITTEE on Fluid Mechanics of the Hydraulics Division of the Society has compiled a list of motion pictures of fluid flow phenomena which would be useful in teaching and for other educational purposes. These pictures cover a variety of subjects, ranging from the conventional model study to study of basic phenomena such as turbulence, diffusion in fluids and rain-drop erosion. The motion pictures may be borrowed from their owners, and in some cases purchased. In general, there is a small rental fee to cover expenses. The list of motion pictures, along with information on where they may be obtained and the rental fees, may be secured from Vito A. Vanoni, Hydrodynamics Laboratory, California Institute of Technology, Pasadena 4, Calif.

Engineers See Need for Greater Use of Their Skills in National Emergency

NEITHER IN MILITARY nor in civilian ...time service was the best utilization ...e of the technical and professional ...ing of America's civil and mechanical ...neers.

This is the overwhelming consensus of ...mbers of ASCE and ASME, as re...ed in the results of the questionnaires ...ulated by the two societies in coopera... with the War and other Federal De...tments. The 13,349 questionnaires ...rned by the deadline date were ...ulated under the direction of E. J. ...der, Research and Development Di...on of the Army. The questionnaires ...e prepared and distributed by the two societies in cooperation with the War Department to obtain data on education, civilian experience in military departments or war agencies during World War II, employment status, occupational status, utilization of engineering experience in civilian wartime employment, as well as in military service, and other factors designed to assist in cataloging engineers for potential national emergency service.

The degree to which members of the two engineering societies feel their technical and professional training and experience were used in military service is tabulated here on a percentage basis.

Utilization Group	ASCE	ASME
(1) You were utilized in your primary field & at your level of competence (training & experience) throughout *most* of your military service	33.7%	34.4%
(2) Utilized as in (1) for *at least half* of the time you were in military service	17.4%	14.1%
(3) Not utilized in your primary field of training & experience, but you *did* utilize throughout your service, the *collateral* fields in which you had received training or gained experience	21.8%	25.9%
(4) Utilized in your primary or collateral fields for only a relatively *short period*	14.4%	11.8%
(5) Utilized in *neither* your *primary nor* in any of your *collateral* fields	12.7%	13.8%

...engineers' opinions on utilization in civilian wartime employment follow:

Utilization Group	ASCE	ASME
(1) Utilized in your *primary* field & at your level of competence (training & experience) throughout *most* of your employment	71.1%	79.3%
(2) Utilized in your *primary* field & at your level of competence *at least half of* your employment	11.3%	11.0%
(3) *Not* utilized in your *primary* field of training & experience but you *did* utilize the *collateral* fields in which you had received scientific training or gained experience	9.9%	6.2%
(4) Utilized in your primary or in collateral fields for only a relatively *short period* of your employment	3.5%	1.8%
(5) Utilized in *neither* your *primary nor* in any of your *collateral* fields in your employment	4.2%	1.7%

...problem of the best possible ...zation of professional engineers in war ...being studied intensively by the Re...rch and Development Division, General Staff Corps, U.S. Army. Engineers Joint Council and the individual Societies concerned are actively cooperating in this effort.

City of Detroit Obtains ASCE Aid in Solving Water Supply Problems

COOPERATION BETWEEN THE City of ...roit and ASCE Headquarters has re...ed in recommendations designed to ...e a disagreement between the Detroit ...artment of Public Works and the ... Water Board over increasing sewer ...lets in the Detroit River to meet ...ing population needs. A proposed ...artment of Public Works program of ...f sewers for the city, involving discharge of excess flows through Fox Creek into the Detroit River at Windmill Point, was opposed by the Water Board on the ground that it would jeopardize the city water supply which is taken from the Detroit River.

At the request of municipal officials, the ASCE secretariat early in 1947 submitted names of engineers especially qualified for this type of study and suggested a procedure for setting up a Board of Consultants, as authorized by the city government. Engineers chosen by the two city departments were ASCE Director Samuel A. Greeley, of Chicago, and Past-President Malcolm Pirnie, of New York, who requested that the third member of the Board be William Storrie, of Toronto, Canada.

Findings of the Board, which have just been announced, indicate that the discharge of combined sewage through Fox Creek into the Detroit River should not be permitted. Instead the Board recommended that overflows be carried about one mile downstream to Conner Creek. On the basis of population estimates of 300,000 by 1970 for the areas along the Detroit River and Lake St. Clair to the north of the city, the Board strongly recommended development of a comprehensive program to keep the sewage out of Lake St. Clair and the upper Detroit River. To implement this program, the Board recommended creation of a Metropolitan District authority and suggested that, until such an authority is established, the Water Board assume responsibility for the design, construction, and operation of such sewage pumping stations as are necessary to prevent the discharge of combined sewage into the upper river and protect the quality of new water.

According to the Board, the city will not have to go to Lake Huron for its water supply, if proper steps are taken to prevent pollution of Lake St. Clair and the Detroit River. To prevent this pollution, the Board recommended that prechlorination facilities be increased and that provision be made for adding chlorination at the Belle Isle intake. It also suggested that, in future developments, longer mixing and settling times and lower filtration rates be provided.

In making its studies and investigations, the Board of Consultants had the assistance and cooperation of George R. Thompson, M. ASCE, Detroit city engineer, and his assistants, F. M. Wagnitz, M. ASCE, and Clyde L. Palmer, Assoc. M. ASCE. Other Society members aiding in the investigations were L. G. Lenhardt and L. V. Garrity, general manager and assistant general superintendent of the Department of Water Supply.

Mead Prize Aspirants Are Urged to Hasten Entries

ONLY A SHORT time remains for preparation and submission of papers for the 1948 Mead Prizes, applicable to both Students and Juniors. In the case of both the Junior Prize and the Student Prize, the

subject for the competitive papers is identical:

> "Is it ethical for a professional engineer employer to utilize the services of a non-technically trained employee so that the latter is led to believe that, through training obtained in performing such services, he may attain a professional rating?"

Deadline for submission to Headquarters is July 1. But before that time the paper has to be presented before some group of the Society, such as a Local Section, a Student Chapter, or a conference of such organizations. Because of this detail, the time remaining, while sufficient, is not a bit too long. Accordingly, immediate attention and action are needed on the part of those interested. These Mead prizes, in keeping with the ideals of their founder, Past-President and Honorary Member Daniel W. Mead, are confined to subjects of professional relations. For this reason, the handling of the competition is under the general supervision of the Society's Committee on Professional Conduct.

Original announcement of the present competition was made in the September 1947 issue, page 52. General specifications for both prizes will be found listed in full in the 1947 yearbook, pages 126 and 127. In addition to those who have already entered the current competition, it is hoped that many others, both Juniors and Students in the Society's Chapters, will also become interested.

Illinois Section Opens Drive for New Members

How the Illinois Section is effectuating the policy regarding obtaining new members, as suggested at his inauguration by President R. E. Doughtery, is illustrated by a sample postcard that recently arrived at ASCE Headquarters. Signed by D. N. Becker, chairman of the Section's Membership Committee, the card reads:

"It is known that there are many civil engineers in our area who are well qualified for membership in the American Society of Civil Engineers who, for some reason or other, have not affiliated with us. If you know of any such engineers will you kindly furnish their names and addresses on the attached card and mail it? The membership committee will then take over in soliciting prospects."

Each member of the Illinois Section received such a card, together with a self-addressed return postcard, on which space was provided for listing prospective members.

Four Sections to Hear ASCE President, Secretary at Fresno Joint Conference

Leading speakers at the first annual California conference of members of the ASCE, sponsored by the four Local Sections in the state, April 23–24, at the Hotel Californian, Fresno, will be ASCE President, R. E. Dougherty and Executive Secretary William N. Carey. Sections sponsoring the two-day meeting will be those of Los Angeles, Sacramento, San Diego and San Francisco, together with their six sponsored Student Chapters at the Universities of California, Southern California and Nevada, Stanford and Santa Clara, and the California Institute of Technology. Two hundred members and approximately 20 representatives of each of the six Student Chapters are expected to attend the meeting, the complete program for which follows.

Friday, April 23

9:00 a.m.
Registration, Hotel Californian
Brief review of points of interest to be covered on inspection trip by R. K. Durant, construction engineer, Bureau of Reclamation, and Col. J. L. Newman, Corps of Engineers

10:00 a.m. to 4:00 p.m.
Inspection trip through Friant Dam and construction work on the Friant-Kern Canal system and at Pine Flats Dam on the Kings River, with luncheon en route.

6:30 p.m.
Banquet. Toastmaster, President Patton of the Fresno Engineers Club. Introductions, Director F. W. Panhorst. Speaker, President R. E. Dougherty

8:30 p.m.
Student Paper Competition—10 minutes each for speakers representing the six Student Chapters that sent delegates.

Saturday, April 24

Morning Session
Chairman, J. L. Burkholder, San Diego
Papers: "Water Plan for California," by Ed W. Hyatt, state engineer, with discussion by S. B. Morris, chief engineer, Bureau of Water & Power, Los Angeles. "Reclamation of Sewage for Irrigation and Domestic Use," by A. M. Rawn, chief engineer, Los Angeles County Sanitation Districts. "Hydraulic Tests of Flow in San Diego Aqueduct," by Fred C. Scobey, U.S.D.A., with discussion by Director Julian Hinds, chief engineer, Metropolitan Water District of Southern California.

12:30 p.m.
Luncheon, Hotel Californian. Toastmaster, John Cunningham, Vice-President, Zone IV. Speaker, Executive Secretary, William N. Carey.

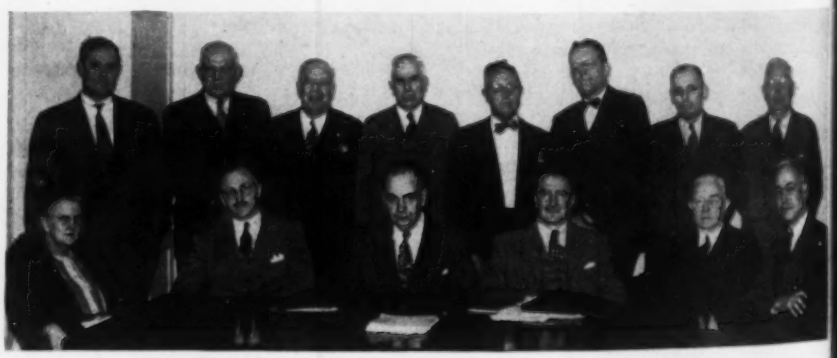
Afternoon Session
Subject: Operation of New Registration Law in California. Speakers: Paul Jeffers, president, California State Board of Registration for Civil & Professional Engineers; L. W. K. Boelter, member of Board; Markham Salsbury, chairman, State Legislative Committee of Engineering Organizations.

Saturday Student Chapter Conference. Subject: Student Chapter Development, with reports from each Student Chapter and discussion of formation of Regional Conference. Chairman of meeting, Richard Clark, president, Stanford University Student Chapter.

Entertainment for Ladies

Friday, April 22, join in field trip, which will traverse picturesque high Sierra foothills, and in the evening banquet.

Saturday, Ladies' luncheon, and special entertainment during afternoon.



HEADING COMMITTEES IN CHARGE OF arrangements for ASCE Spring Meeting at Pittsburgh are, seated left to right: Mrs. W. F. Trimble, Jr., Mr. C. A. Keelen, Col. Charles M. Wellons, general meeting chairman, Gerald G. Greulich, L. A. Paddock, and Ferrand S. Merrill. Standing, in same order, are Mr. G. H. A. Parkman, Jr., Mr. T. P. Watson, E. N. Hunting, Mr. Donald L. Sommerville, Mr. Myron G. Mansfield, Mr. Carlton B. Jansen, Mr. C. Earl Webb, and Mr. Samuel L. Fuller.

Technical Sessions Planned by Nine ASCE Divisions in Pittsburgh

Spring Meeting Scheduled for Steel City, April 7–9

A VARIETY OF expert technical information will be embodied in prepared papers and discussions to be presented before nine ASCE Technical Divisions at the annual Spring Meeting at the Hotel William Penn, Pittsburgh, Pa., April 7–9.

Technical Divisions participating include Air Transport, City Planning, Construction, Highway, Hydraulics, Sanitary Engineering, Structural, Surveying and Mapping, and Waterways. An all-day excursion through two plants of the Carnegie-Illinois Steel Corp. is planned for the final day of the Spring Meeting. A Student Chapter Conference precedes the three-day session on April 6, with ASCE President R. E. Dougherty addressing a luncheon meeting of the group on "The Young Engineer's Future in His Profession."

An "Introduction to Pittsburgh" program will open the Spring Meeting Wednesday, April 7, at which G. G. Greulich, president of the Pittsburgh Local Section, will make a welcoming address. There will be a talk by the Hon. David A. Lawrence, mayor of Pittsburgh, to which Mr. Dougherty will respond on behalf of the Society.

Technical Divisions convening Wednesday afternoon are the Air Transport, Hydraulics, Sanitary Engineering and Structural. Alfred J. Ryan, chairman of the executive committee of the Air Transport Division, will preside at sessions of the symposium on "The Design Approach to Airport Terminal Facilities" highlighting that group's program. Speakers will be J. B. Bayard, Jr., G. Meredith Musick, and H. P. Beach, Jr.

Pollution Abatement Program

Presiding at the Sanitary Engineering Division and Hydraulics Division session will be Harry M. Freeburn, chairman of the executive committee of the group. Speakers include Elmer A. Holbrook, John F. Laboon, Frank L. Flood, John H. Dawson and Richard D. Hoak, addressing the joint meeting of the two Divisions. Subjects for these addresses will include the western Pennsylvania pollution abatement program, the Allegheny County sanitary authority sewerage project, and waste pickle liquor neutralization.

Speakers at the Structural Division meeting, to be presided over by John I. Parcel, its executive committee chairman, will be Leon C. Bibber, F. H. Dill, Tappan Collins, Milton Male, Marshall Holt and J. W. Clark. Subjects include fundamental effects of welding and other thermal fabrication processes, new developments in design of light gage steel, and end connections for struts evaluated by static and fatigue tests on aluminum alloy members.

ADMIRAL BEN MOREELL, Hon. M. ASCE, President of Jones & Laughlin Steel Corp., will be among leading speakers at Spring Meeting, April 7–9, at Pittsburgh. Admiral Moreell, wartime head of Navy Bureau of Yards and Docks, will address Wednesday luncheon meeting on "The Engineer and the Future."

Highways, Waterways Discussion Subjects

Technical Divisions meeting for Thursday forenoon programs include the Highway, Surveying and Mapping, and Waterways. Charles M. Upham, past chairman of the executive committee of the Highway Division, will preside at a symposium on Penn-Lincoln Highway, with speakers E. L. Schmidt, George S. Richardson and Ole Singstad taking part.

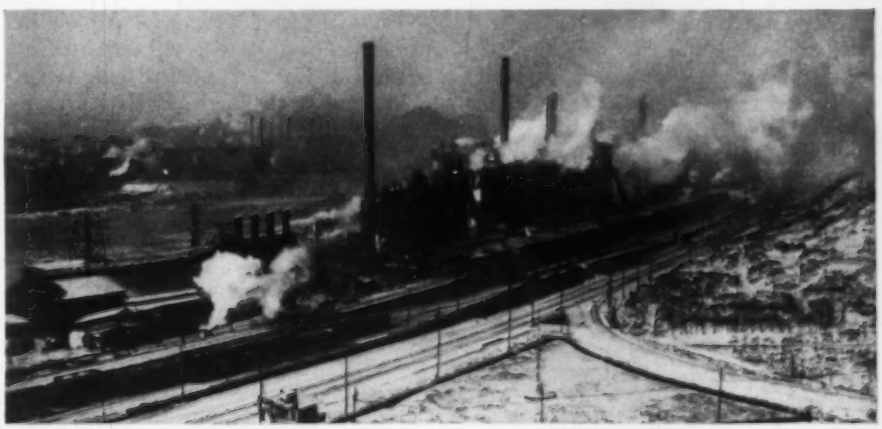
Participating in the Surveying and Mapping program will be Charles B. Taylor, G. Brooks Earnest, Virgil Kauffman, Robert Randall and Ford Bartlett, discussing such subjects as the Pittsburgh city survey, the Cleveland regional geodetic survey, and mapping within cities by photogrammetric methods. J. S. Dodds, chairman of the executive committee of the Division, will preside.

Influence of model testing in the development of lock hydraulic systems, construction methods, and gates and bulkheads at navigation locks for emergency closures and unwatering operations will constitute the subject matter for the Waterways Division session, to be presided over by Ralph L. Bloor, chairman of the Division's committee on design, construction and operation of navigation locks and dams. C. E. Blee, Carlton B. Jansen, A. F. Griffin and Mr. Bloor will be speakers.

Pittsburgh Master Guiding Plan

Divisions meeting Thursday afternoon will be those on City Planning and Construction. Lawrence V. Sheridan, member of the executive committee of the former Division, will preside at that group's discussion of such subjects as the Pittsburgh master guiding plan, development of the Pittsburgh central district, and organizing regional development in Allegheny County. Participating will be Frederick Bigger, Wallace Richards and Park H. Martin.

Speakers on the Construction Division program over which Elmer K. Timby, member of the executive committee of the Division, will preside, are to be Orval Auhl, D. W. Winkelman and S. L. Fuller discussing such subjects as the Bluestone Dam at Hinton, W.Va., contracts and specifications relative to highway construction, and the Edgewood Underpass, Penn-Lincoln Highway.



TYPICAL OF GIANT steel mills in Pittsburgh area to be visited by ASCE members attending Spring Meeting there, April 7–9, is Second Avenue plant of Jones & Laughlin Steel Corp.

NOTES FROM THE *Capital*

E. LAWRENCE CHANDLER, M. ASCE
Eastern Representative, ASCE

NOTE WAS MADE in the February issue of CIVIL ENGINEERING that Congressman Carl Hinshaw, M. ASCE, had introduced H.R. 4884, the "Professional Engineers Registration Act" for the District of Columbia. An identical bill has been introduced in the Senate.

Hearings on H.R. 4884 were held on March 15 before the Judiciary Subcommittee of the House Committee on the District of Columbia. Congressman Hinshaw appeared as the first witness and discussed the provisions of his bill in considerable detail for the benefit of the committee. The Society's Eastern Representative appeared as the next witness, setting forth the need for enactment of such legislation, reviewing the Society's interest and activity for nearly forty years in the country-wide movement for enactment of appropriate state laws to provide for the registration and certification of professional engineers, and expressing the Society's support of H.R. 4884. Others appeared in support of the bill.

A few rather minor objections were raised by some who testified, but none of the points raised were of substantial moment.

Inasmuch as all of our states have laws covering the registration of engineers and regulation of the practice of engineering, it is much to be hoped that H.R. 4884 will become law.

Dues Increase Petitions Are Signed in All ASCE Zones

Petitions bearing more than the required 75 signatures of Corporate Members and Juniors from each of the four ASCE Zones have been signed, requesting Constitutional Amendments to: (1) Increase dues $5 per year for Members, Associate Members and Affiliates, and $2.50 per year for Juniors; and (2) eliminate the $5 per year differential in dues now paid by those residing in District 1 (Metropolitan New York area).

Petition No. 2 carries a contingency clause which makes any constitutional change based upon it dependent upon passage of the amendment contemplated under petition No. 1. In short, unless the membership votes to raise the dues, a vote to eliminate the existing New York residential differential will be void regardless of the number of votes cast for it.

As a result of the petitions received, amendments to the Constitution pertinent to these questions will be considered at the Summer Convention of the Society in Seattle, Wash., July 21, and will be sent to ballot in the fall.

Engineers' Bargaining Group Holds First National Convention in Portland, Ore.

ACTIVITIES OF THE newly organized National Professional Association of Engineers, Architects and Scientists, made up of five Pacific Coast professional employee organizations, were launched on a national scale at a three-day convention, held in Portland, Ore., March 18–20. Newly elected officers of the organization, which was formed to represent professional employees in collective bargaining actions are: Sterling S. Green, Los Angeles, president; Oscar G. Goldman, San Francisco, vice-president; Donald B. Slawson, Portland, secretary-treasurer; and Ralph W. Hutchinson, Sacramento, and Richard A. Henning, Seattle, directors.

During the meeting, a resolution pledging assistance in securing for professional employees in public employment the same rights and benefits as may be obtained for engineers in private employment was passed. Other resolutions stated policies of urging engineer and architect members to apply for registration in their respective states as soon as possible; of encouraging interested organizations having like purposes and standards to affiliate with the National Association; and of requiring Association officers to comply with the requirements of the Taft-Hartley Act as to their acceptability to be qualified Association representatives.

The five associations comprising the new bargaining group have an active membership of more than 1,250. These associations, with their convention delegates, are: the Southern California Professional Engineering Association, Ben F. Collins and Donald R. A. Jones; the San Francisco Area Professional Employees Association, Oscar G. Goldman; the Sacramento Group of Professional Engineering Employees, Orland E. Buckius; the Engineers Guild of Oregon, Kenneth G. Tower; and the Seattle Professional Engineering Employees Association, Richard A. Henning.

Representatives of other groups attending the convention were Dr. R. S. Rasmussen, of the Association of Industrial Scientists (research chemists and engineers employed by the Shell Development Co.) and Dr. J. T. Horeczy, of the Society of Professional Engineers and Chemists, a group employed by the Humble Oil Co. Guests included ASCE Western Representative Walter E. Jessup.

Recent action of the West Coast professional employee groups is the culmination of almost two years of work, during which a constitution was drafted and revised with suggestions from seven professional organizations (see page 480, November 1946 issue of CIVIL ENGINEERING).

Public Engineering Practice and Policy Item Corrected

CIVIL ENGINEERING, March issue, pages 54–55, carried a statement of ASCE policy regarding the use of engineers employed in units of government, national and local. The statement, through a misunderstanding at Headquarters, was published prematurely and before essential editing by a special committee appointed by the Board for that purpose.

The statement, as published, was in preliminary form as approved by the Board subject to editing and clearing by the special committee before publication, and should be disregarded. The statement will be republished in full after editing and clearing by the special committee of the following members:

Robert B. Brooks, Chairman, Consulting Engineer, St. Louis.

Nathan C. Grover, Senior Engineer, U.S. Geological Survey, Washington.

James P. Growdon, Chief Hydraulic Engineer, Aluminum Co. of America, Pittsburgh.

ASCE MEMBER GORDON M. FAIR, dean of Harvard Graduate School of Engineering, is honored by British Institution of Water Engineers with diploma for paper on "Hydraulic Investigation of Water Distribution Systems," regarded as outstanding contribution to sanitary field. Presentation was made to Dean Fair (left) by E. Sherman Chase, M. ASCE, Boston consultant, at meeting of New England Water Works Association.

NEWS OF LOCAL SECTIONS

Scheduled ASCE Meetings

SPRING MEETING

Pittsburgh, Pa., April 7–9
(Board of Direction meets April 5–6)

ANNUAL CONVENTION

Seattle, Wash., July 21–23
(Board of Direction meets July 19–20)

Coming Events

Alabama—First one-day meeting of the year, to be held during fourth week in April for a discussion of topics of current interest to local engineers. Exact date, and place of meeting will be indicated in notices to members of the Section.

Central Ohio—Meeting at the Oxley Hall tea room, Ohio State University, Columbus, April 14, at 6:30 p.m. Joint meeting with members of the Student Chapter at Ohio State University.

Cleveland—Meeting at the Cleveland Engineering Society, Cleveland, April 16, at 8 p.m. Dr. Oliver A. Ohman, of the Cleveland office of the Standard Oil Co., will speak. Meeting preceded by dinner at 6:30 p.m.

Colorado—Dinner meeting at the Oxford Hotel, Denver, April 12, at 6:30 p.m.

Connecticut—Meeting in Hartford April 7, at 6:30 p.m., at a place to be announced.

District of Columbia—Meeting with the Washington Society of Engineers in the Interior Department Auditorium, Washington, D.C., April 21, at 8:15 p.m.

Florida—Meeting in conjunction with the annual convention of the Florida Engineering Society at the Orange Court Hotel, Orlando, April 23–24.

Maryland—Meeting in the Engineers Club, Baltimore, April 14, at 8 p.m. Preceded by cocktails at 6 p.m. and dinner at 7 p.m.

Metropolitan—Meeting in the Engineering Societies Building, New York, April 21, at 8 p.m.

Mid-South—Technical meeting at the Hotel King Cotton, Memphis, Tenn., May 7, at 9:30 a.m. To be devoted to papers on the new highway bridge across the Mississippi River at Memphis and to a traffic survey now being made in that city.

Mohawk-Hudson—Meeting at Union College, Schenectady, April 13, at 8 p.m., jointly with Union College and Rensselaer Polytechnic Institute Student Chapters.

Montana—General business meeting at the Montana Power Co. assembly room, Helena, April 9, at 8 p.m. A. H. Tuttle, geological survey engineer, will talk on "Water Resources."

New Mexico—Joint meeting with the El Paso Branch of the Texas Section at the College of Mines, El Paso, May 7 and 8. Banquet May 7. Papers will be presented May 8 by Student Chapter members from Texas A. & M., College of Mines; Universities of Arizona and New Mexico and New Mexico A. & M.

North Carolina—Spring meeting at the engineering building, Duke University, Durham, May 1 at 10 a.m.

Northwestern—Meeting at the Minnesota Union, University of Minnesota, Minneapolis, April 15, at 6:30 p.m. Meeting at Coffman Memorial Union, May 3, at 6:30 p.m. Student Chapter prize winners will be announced.

Oklahoma—Joint meeting at Sever's Hotel, Muskogee, April 16 and 17, with Student Chapters from Universities of Arkansas and Oklahoma, Oklahoma A. & M. College and Mid-South Local Section.

Philadelphia—Joint meeting with the Engineers' Club of Trenton at the Stacey-Trent Hotel, Trenton, N.J., April 8, at 8 p.m. Dr. E. W. Engstrom, of the RCA laboratories, will speak. Preceded by inspection trip in the afternoon and dinner at 6:30 p.m.

San Francisco—Dinner meeting at the Engineers Club of San Francisco, San Francisco, April 20, at 6 p.m. Frank Kidner, of the school of business administration, University of California, will speak.

St. Louis—Luncheon meeting at the Hotel York, St. Louis, April 26, at 12:15 p.m.

Seattle—Joint meeting with University of Washington Student Chapter at the University Commons, Seattle, April 28, at 6:15 p.m. Student Chapter papers will be judged.

Texas—Spring meeting at Corpus Christi, April 22–24. Headquarters will be at the White Plaza and Driscoll Hotels jointly. Conrad Blucher, of Corpus Christi, is general chairman.

Tri-City—Meeting at the Hotel Muscatine, Muscatine Iowa, April 22, at 6:30 p.m.

Wisconsin—Meeting at Madison April 29 at 7:30 p.m. R. B. Wiley, ASCE Vice-President, will speak on Society affairs. Meeting preceded by dinner at 6:30 p.m.

Recent Activities

AKRON

PROBLEMS INVOLVED IN the design of the new high level bridge, now under construction for the City of Akron, were discussed at the first 1948 dinner meeting of the Section by Prof. John B. Scalzi, of the Case Institute of Technology. Professor Scalzi is also structural engineer for the Cleveland firm of Wilbur Watson Associates, which designed the project. A feature of the meeting was the presentation of certificates of life membership to M. P. Lauer and Stanley Macomber.

ARIZONA

THE CURRENT BRIDGE construction program of the Arizona Highway Department was outlined at a recent meeting by R. A. Hoffman, chief bridge design engineer for the department. Of special interest was the speaker's description of problems encountered in the construction of one of two $400,000 bridges being built on the Superior-Miami Highway. In building the piers, the presence of two abandoned mining tunnels that caused caving was discovered. It was found necessary to backfill the tunnels with concrete before the piers could be constructed. Showing of a sound motion picture, entitled "The Bell Telephone Hour," concluded the technical program. The film showed the progress that is being made in transmission of radio broadcasts by buried lead cables, coaxial cables, and the still new micro-wave methods.

CENTRAL ILLINOIS

GREATER EMPHASIS SHOULD be placed on a study of soil types in relation to construction methods and the speed that can be made in tunnel excavation, if costs are to be kept down, Karl Terzaghi, professor of the practice of civil engineering at Harvard University, told Section members at a recent meeting. In a talk on "Soft Ground Tunneling," Dr. Terzaghi pointed out that the rate of progress in boring the tunnel has a much greater effect on the cost of the job than does the thickness of tunnel tubes. ASCE Director Samuel A. Greeley, of the Chicago

firm of Greeley & Hansen, led a discussion of Society affairs and proposed dues increase amendments at another recent meeting.

CENTRAL OHIO

WORK OF THE U.S. Geological Survey in cooperation with the Ohio Water Resources Board, to assist local municipalities and industries in their quest for adequate water supplies, was described at a recent meeting by D. W. Van Tuyl and Edward Schaefer, engineers for the Survey. Slides showing the results of Survey studies on ground-water recharge in the Canton area, supplemented their talks.

CINCINNATI

DEVELOPMENT AND IMPROVEMENT of railroad materiel were covered by L. S. Crane, assistant engineer of tests for the Southern Railway System, Alexandria, Va., at a recent meeting. Mr. Crane's talk, which ranged from the cause, detection, and elimination of transverse fissure failures in rail to the stabilization of poor subgrade soils, elicited an enthusiastic discussion from the floor. New Section officers, announced during the evening, are: Carl F. Renz, president; Truman P. Young, vice-president; and John A. Diehl, secretary-treasurer.

CLEVELAND

"CHARTING THE COURSE for Tomorrow's Education" was the subject of a talk given at the Section's annual meeting by T. Keith Glennan, new president of the Case Institute of Technology. Special features of the program included the presentation of certificates of life membership to Rowland G. Rice and James G. Esch, and of the ASCE Wives scholarship award to L. Hodson, Student Chapter member at Ohio Northern University. New officers, installed by Section Past-President G. Brooks Earnest, are Wendell R. Swatosh, president; Howard F. Schryver, vice-president; and Alfred D. Yanda, secretary-treasurer. The technical program at another recent meeting consisted of a talk by Robert C. McDowell on the large freight unloaders developed in connection with Great Lakes transportation.

COLORADO

COMPARISON OF EUROPEAN and American city planning methods was made at a recent meeting by M. Walter Pesman, Denver city planner and landscape architect, who has just returned from a visit to outstanding cities in northwestern Europe. Citing the important advances in planning made in Rotterdam, Prague, Stockholm and other cities, Mr. Pesman pointed out that they are adopting many features developed in the United States, such as divided highways, braided intersections, civic centers, zoning, belt and penetration lines, and mass transportation. A talk on the Friant-Kern Canal Project at Friant, Calif., by E. C. Smallin, engineer for the U.S. Bureau of Reclamation, concluded the technical program. Mr. Smallin stated that the 160-mile canal is one of the largest lined canal projects undertaken by the Bureau of Reclamation. The typical concrete section has a bottom width of 36 ft, is 17 ft deep, and has a width of 80 ft between flow lines.

IOWA

USES, MANUFACTURING METHODS, and research developments in the concrete pipe industry were outlined by Howard F. Peckworth, managing director of the American Concrete Pipe Association, Chicago, at a joint meeting with the Iowa State College Student Chapter. A talk on "Sub-Surface Explorations for Foundations of a Bridge Over the Mississippi at Clinton" comprised the technical program at another recent meeting. This was given by Bert Meyers and Frederick Dorheim, respectively, engineer of materials and tests and geologist for the Iowa Highway Commission. A special feature of the meeting was the presentation of Section awards of Junior membership in the Society to Ellis Pickett, of Iowa State College, and Kenneth Bright, of the State University of Iowa.

CONNECTICUT

ASCE VICE-PRESIDENT Carlton S. Proctor attended the Section's annual meeting and spoke on current Society activities, commenting particularly on the necessity for the recent budgetary curtailments. Mr. Proctor, a New York City consultant, also discussed some of his experiences in handling foundation problems. During the evening certificates of life membership were presented to A. S. Lynch and C. E. Smith. Other recipients, not present at the meeting, are Robert J. Ross, W. W. Chapin, J. N. McKernan, and A. J. Provost, Jr. Francis L. Castleman, Jr., was elected president during the business session, and Frank. Ragaini, vice-president. Harold L. Blakeslee remains as secretary-treasurer.

FLORIDA

PROPER STREAM SANITATION to preserve the recreational facilities of Florida streams was urged by Earle B. Phelps, acting professor of sanitary engineering at the University of Florida, in a talk before a recent dinner meeting. Sewage plants must be elevated from their former low and unattractive status to vie with highways, schools and other public interests for the city budget dollar, Professor Phelps declared. He cited the new disposal plant at the University of Florida as an excellent example of modern planning with landscaping of the grounds. Revision of the present Jacksonville Building Code to include revised specifications of the American Institute for Steel Construction was also discussed, and a committee appointed to study the matter.

KANSAS

A PICTURE OF the present-day economic condition of Europe was presented at a recent dinner meeting by Gerald Gordon, of the Associated Industries of Kansas. Mr. Gordon supplemented his talk with pictures that he had taken on a recent European tour. W. K. Dinklage was program chairman.

MARYLAND

THE EFFECT OF past events on the problems of today, especially as they pertain to the engineering profession, was discussed at a recent dinner meeting by ASCE Director W. R. Glidden in a talk entitled "The Headlights of Experience Light the Road Ahead." The proposed plan for redistricting the membership of the Society was discussed during the business session.

KANSAS CITY

A DIVERSIFIED PROGRAM of activities, including monthly technical meetings and several inspection trips, has been enjoyed by the Juniors of the Section during the past year. The group was organized a year ago under operation of a Junior Activities Committee, headed by W. G. Riddle. Others who have served on the committee in varying capacities are J. H. Bateman, Robert Spiegel, D. E. Harper, E. H. Allen, Jr., Lee Nelson, and E. J. Daily. Daniel B. Hapke is in charge of publicity.

METROPOLITAN

PRESENT WELDING PRACTICES of the Navy Bureau of Yards and Docks were outlined at the March meeting by Comdr. L. C. Coxe, head of the Design Division of the Bureau. He was followed on the program by A. Amirikian, structural engineer for the Bureau of Yards and Docks, who explained future developments in the field as the Bureau sees them. There was an attendance of 250 at the meeting, which was held jointly with the New York section of the American Welding Society.

Construction difficulties in permafrost areas, such as Alaska, northern Canada, and Siberia, were discussed at a meeting of the Junior Branch of the Metropolitan Section by Joseph D. Lewis, engineer for the New York City Board of Water Supply. At another recent meeting, members of the Branch heard Gilmore D. Clarke, New York City consultant and landscape architect, speak on measures being taken for the relief of traffic congestion in New York.

MIAMI

TRAFFIC PROBLEMS OF metropolitan Miami were outlined at the March meeting by a panel of local traffic engineers headed by Earl Reeder, director of traffic and transportation for the City of Miami. Others taking part in the discussion were J. W. Hoover, traffic director for the City of Miami Beach; T. M. Vandergempel, traffic engineer for the Miami Transit Co.; and Robert Finley, manager of the American Automobile Association of Miami. Suggested solutions to the traffic problem, which is seasonal, include scattered bus terminals for mass transportation rather than a central terminal, and provision of off-street parking facilities in the downtown areas.

MONTANA

OPERATIONS OF THE Northern Pacific in Montana were detailed by Robert E. Rhode, Section Junior and division engineer for the railroad, at a recent meeting. The first northern transcontinental railroad, the Northern Pacific, was completed 65 years ago at Gold Creek, Mont. Recent innovations, Mr. Rhode stated, include centralized traffic control between Helena and Garrison by means of signals, without the use of train orders. During the business meeting J. H. Thomas was named chairman of a committee to study a vocational guidance program.

NEW MEXICO

ASCE Western Representative Walter E. Jessup attended a recent meeting and spoke on aims and activities of the Engineers Joint Council, commenting particularly on the EJC report, "The Engineering Profession in Transition." A general discussion of Society affairs centered about the decrease in the ASCE budget and the cut in Local Section allotments.

NORTHWESTERN

DEVELOPMENT OF WATER resources and supplies in the United States during the last half century was outlined by L. N. Thompson, general manager of the St. Paul Water Department, at the March 1 meeting of the Section. He was followed by Edgar W. Johnson, superintendent of the Minneapolis Water Department, who described the treatment given the Minneapolis water supply and the experimental treatment work being done in that city. Showing of slides of the St. Paul supply included the program.

OKLAHOMA

THE IMPORTANCE OF a cooperative approach on the part of management in management-labor relations was stressed by Frank H. Willibrand, division manager of the Sohio Petroleum Co., in a talk given at the Section's first meeting of the year. ASCE Director Webster L. Benham was the other speaker appearing on the program. After reporting the Society's annual meeting, Mr. Benham gave an illustrated talk on the new Oklahoma City sewer system now under construction.

OREGON

ENGINEERING CONDITIONS IN the Middle East were reviewed at a recent meeting by N. C. Pearson, chief engineer of the Bechtel Engineering Corp., which has had various engineering assignments in Saudi Arabia and other parts of the Middle East. At the request of the Section, ASCE Vice-President John W. Cunningham explained the need for increasing Society dues and the proposed new zoning and redistricting changes. A general discussion of the financial condition of the Section concluded the program.

ROCHESTER

ENGINEERS MUST IMPROVE their public relations by selling the public on the fact that the pricing of their product, and especially construction costs, are in line with or below that of other industries, C. Storrs Barrows, Rochester architect, told members of the Section at a recent meeting. In a talk on the basic economics of building construction, Mr. Barrows stated that although the trend of construction costs is still up, as it has been over a 60-year period, the index cost of housing is still below that of most other commodities. However, he said, rising costs must be stopped by relaxing government controls before they cause an outpriced market with resultant stagnation.

SACRAMENTO

SACRAMENTO'S WATER SUPPLY and sewage disposal problems were discussed at a regular luncheon meeting by Carl M. Hoskinson, superintendent and chief engineer of the Sacramento Division of Water and Sewers. Other luncheon meeting speakers include Fred Grumm, deputy state highway engineer for the California Division of Highways, who outlined proposed improvements in the state's highway system; M. J. Brickley, registrar of Sacramento Junior College, who spoke on the Palestine situation; and Charles Muskavitch, conservator of art for Crocker Art Gallery, whose subject was "Conservation of Art."

PITTSBURGH

RECENT DEVELOPMENTS IN foundation engineering in their application to bridges and buildings were summarized by R. P. Davis, acting dean of the college of engineering at West Virginia University, at a joint meeting with the Civil Section of the Engineers' Society of Western Pennsylvania on March 5. At the Section's annual meeting, a progress report on plans for the Society's Spring Meeting, to which the Pittsburgh Section will be host, was given by C. M. Wellons, general meeting chairman. The rest of the program consisted of a report on the ASCE Annual Meeting, given by William A. Conwell, and the presentation of a certificate of life membership to James C. Jordan. Section recipients in absentia are Bernard H. Prack, John D. Stevenson, and Daniel H. Martin.

LADIES OF PITTSBURGH SECTION have pre-meeting get-together to arrange final details of entertainment for visiting ladies at ASCE Spring Meeting. Seated, left to right, are Mrs. Samuel L. Fuller, Mrs. John P. Frazier, Mrs. Gilbert H. Atwood, Mrs. Gerald G. Greulich, Mrs. Willard H. Buente, Mrs. Daniel E. Davis, and Mrs. Ferrand S. Merrill. Shown in same order, standing, are Mrs. George S. Richardson, Mrs. William N. Dambach, Mrs. G. H. A. Parkman, Jr., Mrs. Frank R. Burnette, Mrs. C. A. Keelen, Mrs. Estep T. Gott, Mrs. Carlton B. Jansen, Mrs. Donald L. Sommerville, Mrs. Myron G. Mansfield, Mrs. W. F. Trimble, Jr., chairman of Women's Activities Committee, and Mrs. Charles W. Doerr.

ST. LOUIS

DEVELOPMENT OF THE Jefferson National Expansion Memorial as "the government's contribution to a fitting observance of the 150th anniversary of the Louisiana Purchase" in St. Louis in 1953 was urged at a luncheon meeting of the Section by Julian C. Spotts, superintendent of the Jefferson National Expansion Memorial of the National Park Service. Mr. Spotts traced the development of the memorial project, which has resulted in selection of a $40,000 prize-winning design for a steel arch 590 ft high. Proposed government development of the river-front area as a national park will require settlement of two engineering problems—details of the interregional highway along Third Street and the disposition of the elevated tracks along the wharf—Mr. Spotts pointed out. Following a recommendation of the executive committee, the Section unanimously endorsed the candidacy of Robert B. Brooks for ASCE Vice-President from Zone III.

SAN DIEGO

PROPER FERTILIZATION OF soil as a means of combating nutritional diseases was advocated by E. J. Mehren at a recent meeting of the Section. Speaking on the subject, "A New Outlook in Agricultural Research," Mr. Mehren stated that in many areas the mineral content of the soil has been exhausted, with consequent bad effects on the vegetation produced, and urged the wide use of compost, which furnishes the soil with necessary bacteria as well as humus.

SAN FRANCISCO

A TALK ON "Some Engineering Phases of Construction," by Jack Singleton, chief engineer for the American Institute of Steel Construction, New York, comprised the technical program at a recent meeting of the Section. Mr. Singleton supplemented his talk with a sound film on the manufacture of steel, entitled "Steel—Man's Servant."

SEATTLE

POSSIBLE BRIDGE CROSSINGS of Puget Sound and adjacent waters were discussed at a recent meeting by a panel of local engineers, headed by Homer Hadley, Seattle consultant. Other speakers were Clarence B. Shain, director of highways for the State of Washington, who described the present status of engineering studies and legislation in regard to proposed crossings; and Charles E. Andrew, consulting engineer for the Washington State Toll Bridge Authority, who summarized the results of his studies of the problem, drawing a comparison with the San Francisco Bay crossing situation. During the Section's annual meeting, the following new officers were elected: B. P. Thomas, president; E. L. Strandberg, vice-president; and T. H. Campbell, secretary-treasurer.

SOUTH CAROLINA

SPEAKERS AT THE annual winter meeting, held jointly with the South Carolina Society of Engineers in Columbia, included L. R. Lee, of the General Electric Co., Schenectady, N.Y.; Frank C. Owens, mayor of Columbia; Mark C. Fox, project manager of the Grannis, Thompson & Street Co., Charlotte, N.C.; J. H. Stephens, of the South Carolina State Board of Health, Columbia; and Dr. Henry R. Sims, president of Winthrop College, Rock Hill, S.C. During the annual business meeting, Walter E. Rowe was elected Section president for 1948, D. D. Curtis will remain as vice-president for another year, and Albert E. Johnson as secretary-treasurer.

SPOKANE

ASCE DIRECTOR W. L. Malony attended a recent business meeting of the Section and spoke on current activities of the Board of Direction. A talk on Section affairs, headed by President Harold J. McCoy, constituted the remainder of the program. The Section has announced that it is sponsoring another student paper prize contest, open to students of the University of Idaho and Washington State College.

TACOMA

LUMBER EXPERTS PROVIDED the program for a joint meeting of the Section and the Tacoma Engineers Club. Various aspects of lumber grading were discussed by a panel of speakers, including A. C. Horner, of the National Lumber Manufacturers Association, San Francisco; W. T. K. May, director of technical service, West Coast Lumbermen's Association, Portland, Ore.; and Knute Anderson, supervisor of the West Coast Bureau of Lumber Grades and Inspection. An innovation in the form of a lumber-grading contest, sponsored by the West Coast Lumbermen's Association, concluded the program. Winners of the contest were Harold Sitts, Burwell Bantz, and N. E. Olson.

TEXAS

IMPORTANCE OF ENGINEERS in the life of the nation was stressed by ASCE Director C. Glenn Cappel in a talk before the March 1 luncheon meeting of the Dallas Branch. In a résumé of current Board of Direction activities, Mr. Cappel stated that the profession must increase its participation in civic affairs.

Abnormal growth of Fort Worth, in conjunction with recent cost increases, has made completion of the city's postwar improvement program difficult, W. O. Jones, city manager of Fort Worth, told members of the Branch there at their regular luncheon meeting. One of the principal problems confronting Texas cities, he said, is the limited means of raising taxes.

TOLEDO

TECHNICAL ASPECTS OF city planning were covered by Lloyd Keefe, chief of the planning section of the Toledo City Planning Commission, at the first meeting of the year. Discussion of the proposed increase in ASCE dues and of the proposed redistricting and zoning changes constituted the rest of the program.

TENNESSEE VALLEY

PROGRESS MADE IN community planning at Oak Ridge was cited by City Manager L. Z. Dolan at a regular monthly dinner meeting of the Knoxville Sub-Section. In a talk on engineering aspects of the Oak Ridge development, Mr. Dolan explained the governmental organization of the project and its relationship to the county, state, and federal governments.

Operation of a power system was discussed by John F. Meagher, manager of the Elizabethton (Tenn.) Electric System, at a recent dinner meeting of the Holston Sub Section.

Diverse applications of bellows were discussed at a meeting of the Oak Ridge Sub-Section by Ernest Zurcher, development engineer at the Y-12 plant of the Carbide and Carbon Chemicals Corp. Mr. Zurcher explained the application of bellows to such uses as temperature control, shaft seals, and packless valves and commented on a special use in compensating for altitude and airspeed for the Sperry Bomb Site.

TRI-CITY

A PANEL DISCUSSION on flood fighting and the effects of floods was presented at a recent meeting in Davenport, Iowa, by five members of the Rock Island Engineer District of the Corps of Engineers. Participants in the program were G. M. Wood, A. F. Burleigh, R. G. Stearns, L. A. Carlson, and A. P. Rinell.

VIRGINIA

EXPRESS HIGHWAYS THROUGH cities were discussed by Carlton N. Connor, chief of the Urban Plans Section of the Public Roads Administration, at a joint dinner meeting of the Section and the Central Virginia Engineers Club. Other speakers were Burton Marye, of the Virginia State Highway Department; R. Stuart Royer, consulting engineer of Richmond; and Gamble M. Bowers, head of the Richmond Department of Public Works. The two latter discussed the proposed expressway through Richmond.

STUDENT CHAPTER *Notes*

CITY COLLEGE OF NEW YORK

DIVERSE activities occupied Chapter members during March, beginning with a get-together and dance, to which prospective members were invited. Harry T. Immerman, chief engineer of the New York firm of Spencer, White & Prentis, Inc., spoke at a technical meeting, using slides to illustrate his lecture on "Underpinning and the Pretest Method." Alumni were special guests of the Chapter at the semiannual induction program, highlight of the spring schedule.

MARQUETTE

AN ANALYSIS OF the proposed Milwaukee expressway was given by Raleigh W. Gamble, coordinator of expressways for the City of Milwaukee, at the first 1948 meeting of the Chapter. A bowling party for Chapter members and their guests concluded the evening. A recent membership drive resulted in a tremendous increase in membership. New Chapter officers are: John Hofstedt, president; Stewart Fonda, vice-president; Thomas Voros, secretary; and Clayton Harley, treasurer.

IOWA STATE COLLEGE

THE CHAPTER RECENTLY reached its goal of 250 members. Recent guest speakers include Howard F. Peckworth, director of the American Concrete Pipe Association, Chicago. New Chapter officers are: Roscoe Hungett, Jr., president; Bert Sieck, vice-president; Don French, secretary; F. O. Johnson, recording secretary; and Harold Broughton, treasurer. Wayne Swan and Bob Davies are senior and junior representatives, respectively; Jack Russell, editor of *The Transit*, Student Chapter publication; Vern Swanson, chairman of public relations; and Carleton Roskamp, in charge of the Veishea open house.

NORTH CAROLINA STATE COLLEGE

STUDENT CHAPTER MEMBERS are taking an active part in preparations for the annual "Engineers Fair," highlight of the spring schedule at the college. At the first meeting of the present semester, the Chapter heard a talk on sanitary engineering, given by Albert Kozma, engineering consultant of Raleigh. As a result of a recent membership drive, the present Chapter enrollment is 160. Officers for 1948 are: S. Norwood Richardson, president; Lowell F. Liles, vice-president; Edward G. Oakley, secretary; and Robert B. Ray treasurer. Kenneth L. Coble is editor of *On the Level*, Chapter publication, and Ray J. Queen reporter.

OKLAHOMA A. & M. COLLEGE

A NUMBER OF Chapter members made a field trip to Oklahoma City on March 3 for a tour of the Robberson Steel Co. Following a luncheon as guests of the company, the group spent the afternoon going through the testing laboratories of the State Highway Department and the Metropolitan Paving Co. ASCE Mid-Western Representative George S. Salter spoke at a recent smoker meeting. He urged students to take an active part in ASCE affairs and to plan their futures to become not merely technicians but well-rounded individuals capable of executive and managerial responsibilities.

RENSSELAER POLYTECHNIC INSTITUTE

The C.E. News, first publication in the history of the Chapter, made its appearance recently. Issued on the morning before each meeting, it will contain information intended to prepared members for the subject matter to be discussed at the meeting. The Chapter membership drive will continue, with prizes awarded those bringing in the largest number of new candidates. Frank R. Sherman spoke at a recent meeting on his experiences as chief engineer on a pier-placing job for the government in the port of Monrovia, Liberia. The Chapter is planning an engineers' open house for April 23 and 24.

UNIVERSITY OF MISSOURI

POSSIBILITIES OF EMPLOYMENT in the field of sanitary engineering were reviewed at a recent Chapter meeting by Scott Johnson, director of environmental health for the State of Missouri. Other recent speakers include E. C. L. Wagner, secretary and general manager of the Associated General Contractors of Missouri, who addressed the group on engineering contracts. An engineers' picnic, highlight of the spring, is planned for this month. With almost a triple increase in membership and meeting attendance, the Chapter is having one of the best years in its history.

UNIVERSITY OF WISCONSIN STUDENT CHAPTER has large postwar enrollment. Part of 1947–1948 membership, which is having active school year, is pictured here.

NEWS BRIEFS

Port Authority Offers Plan to Improve Hudson Waterfront

A $114,000,000 PORT rehabilitation program, extending over a twelve-year period and involving the leasing of city-owned waterfront properties to the Port of New York Authority for 50 years, has been proposed by the Port Authority. The plan would place all of the 156 city-owned pier structures, including the Foreign Trade Zone area on Staten Island, under the operation of the Port Authority and guarantee the city a rental averaging $5,072,000 annually for 40 years. City piers and other port facilities would continue in full activity during the rebuilding process.

The cost of new construction, which would include six piers, four big railroad carfloat stations, and the world's largest produce terminal market on the Hudson River in lower Manhattan, is estimated at $86,910,820. The cost of the secondary rehabilitation program, involving modernization of piers and bulkheads, would be $27,152,135. Modernization of port structures would include installation of fire-prevention devices to combat waterfront fire losses that have averaged $1,000,000 annually during the past 15 years.

Consolidation of railroad port activities and virtual elimination of costly traffic congestion and trucking delays in the port area would result in an annual saving to the city of $25,000,000, it is predicted. Other annual savings claimed for the Port Authority plan include the following: operating costs and vessel delays in port, $7,250,000; expediting non-perishable freight deliveries through carfloat stations, $1,640,000; and a reduction in the terminal cost of selling and handling food, $9,000,000.

Other plans for the rehabilitation of the Hudson River waterfront have already been presented to Mayor O'Dwyer's special committee studying port improvement by the World Trade Corp. (CIVIL ENGINEERING for December 1947, page 72) and the Commissioner of Marine and Aviation. Cost of the plan suggested by the World Trade Corp., an organization created in 1946 by the New York State legislature to study the city's water-traffic facilities and undertake their improvement, is estimated at $250,000,000, and that of the Department of Marine and Aviation at $55,000,000.

Construction for 1947 up 8 Percent Above Previous Year

MINOR REVISIONS IN year-end data necessitated a slight downward revision, to $12,825 million, in previously published estimates of total value of new construction activity during 1947. The revised total for last year is some 30 percent greater than the value of 1946 new construction activity ($9,890 million) and, in dollar terms, ranks 1947 just below the 1942 construction peak of $13,350 million, according to a recent U. S. Department of Commerce Industry Report.

A major part of the 30 percent jump between 1946 and 1947 probably can be attributed to increasing costs. Measured in terms of constant dollars, the 1947 physical volume of new construction was only 8 percent above that of 1946. Physical volume of all publicly financed new construction in 1947 was up 16 percent from 1946; total privately financed new construction, 5 percent. Significantly, the 1947 physical volume of new privately financed housing construction put in place was 27 percent higher than that of the previous year, in sharp contrast with the 5 percent overall increase in total private construction. New privately financed permanent dwelling units started during 1947 were also 27 percent above the 1946 total.

New construction put in place during January 1948 amounted to $1,106 million. This total represents a less than seasonal drop of 6 percent from December, and was 32 percent above the January 1947 total.

What effect the recent market break in many commodity prices on one hand, and the end-of-February hike in steel prices on the other, may have on construction costs and building material prices, cannot be gaged at this time. Latest available data, covering the month of December 1947, indicate a continuation of the pattern of rising costs and prices through that month.

The Bureau of Labor Statistics index of construction materials (wholesale) prices, with 1939 equal to 100, reached 211.0 in December. The December index was 1.9 percent higher than that of November and 21 percent above that for December 1946.

Construction costs rose some 18 percent during 1947 and at the end of the year were more than double those of 1939. The Commerce Department's Composite Index of Construction Costs for December reached a level of 206.5 (1939-100), an increase of 1.4 percent from the previous month's index.

Final tallies on 1947 output of building materials, now becoming available, establish 1947 as a banner production year. As measured by the Department's Composite Index of Production for Selected Construction Materials, overall output of building materials reached a new peak during the year. Preliminary figure for the 1947 Index is 139.6 (1939-100), up 11.6 percent from 1946, and 4.2 percent higher than the previous peak reached in boom-year 1925.

Production and shipment data now available indicate that the output of several major materials set new records during 1947. Record breakers include portland cement, asphalt roofing materials, gypsum board and lath, structural clay tile, hardwood flooring, cast iron soil and pressure pipe, warm air furnaces, and building boards. However, area shortages of some materials, notably gypsum products and cast iron and steel items, persisted throughout the year.

Preliminary estimates of total 1947 construction activity by states disclose no major alterations of the regional pattern prevailing during 1946. As in 1946, the area leading in construction during 1947 was the East North Central region, comprising the states of Ohio, Indiana, Illinois, Michigan and Wisconsin. These states combined to account for 19.4 percent of the 1947 national construction total.

The F. W. Dodge Corp., a fact-finding organization for the construction industry, reported that the dollar volume of construction contracts awarded in the 37 states east of the Rocky Mountains set a new high mark for January in the Dodge statistical series dating from 1925. January 1948 awards totaled $615,206,000, and represented a gain of 8 percent over January of last year when the previous dollar volume high for the month was reported. January 1948 awards, however, were 2 percent less than the total for December.

Again in second place during 1947, with 17.6 percent of the national total, was the Pacific Coast region—California, Oregon and Washington—while the Middle Atlantic region—New York, New Jersey and Pennsylvania—occupied third place with 16.8 percent.

Among the individual states, California again led by a wide margin, accounting for $1,746.9 million of new construction during 1947. Texas displaced New York as the second-ranking state with $908.3 million of new construction in 1947, as against $905.9 million put in place in New York.

Texas Firm Applies for New Pipeline Authority

APPLICATION HAS BEEN made by the Texas Eastern Transmission Corp. to the Federal Power Commission for permission to construct and operate a pipeline parallel to its Big Inch pipeline. Designed to bring natural gas from the Southwest to gas-distributing companies on the Eastern Seaboard and in the Appalachian area, the proposed line, 26 in. in diameter, would run 1,020 miles over the Big Inch line right

way to a point about 20 miles east of
d Ridge, Pa., where it would tie in
h existing Big and Big Little Inch lines
carry natural gas to Philadelphia and
den, N.J. Extensions then would be
to areas on the Eastern Seaboard, where
may be determined that gas is most
ded in the public interest.

Larger than the Big Inch, the 26-in. line
uld be designed to deliver 425,000,000 cu
of gas daily, the application indicates.
this, 39,000,000 cu ft a day would be sold
the Appalachian area and 386,000,000 cu
daily would be delivered for use in the
tern Seaboard area. Estimated cost is
2,131,000.

Proposed also is the construction of about
miles of 26-in. pipe from Longview,
., to gather natural gas at sources of
ply, 25 gas compressor stations with an
regate installed horsepower of 244,840
the 26-in. line at the present existing
mpressor station sites of the Big Inch
eline, and five compressor stations with
sepower of 69,900 on the lines between
nd Ridge, Linden and Philadelphia.

FWA Announces Engineering Works for Virgin Islands

TWO IMPORTANT ENGINEERING projects intended to improve living conditions in the Virgin Islands will be started this summer by the Federal Works Agency, it is announced by Federal Works Administrator Philip B. Fleming, M. ASCE.

Following a detailed survey of the water resources of the Island of St. Thomas, seat of government, the FWA will begin work on a $1,000,000 supply project for the Island, involving construction of catchment areas, impounding dams, covered storage reservoirs, treatment facilities, and supply and distribution lines. The project is aimed at increasing the supply of fresh water for a population of about 12,000 to at least 10 gal per capita per day. Experiments in the solar distillation of sea water will be made to increase the supply on St. John, smallest of the three islands in the group.

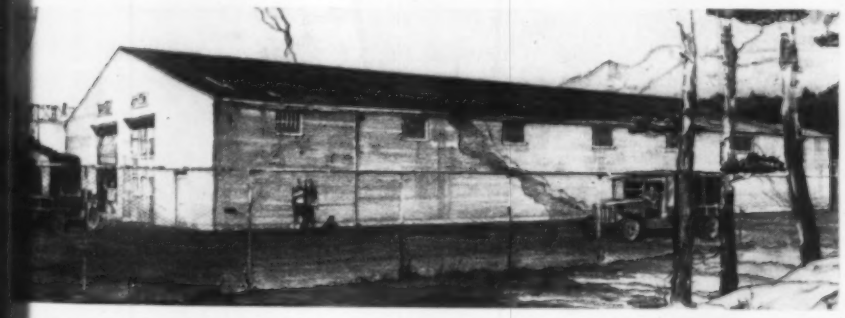
Development of the waterfront at Charlotte Amalie, St. Thomas, to promote commerce and industry throughout the Islands will constitute the other improvement. This project, which will cost about $1,250,000, will involve reclamation of swamp areas along the waterfront and construction of a bulkhead to provide wharf and mooring facilities for small craft.

Government work now under way in the Islands includes the building of sewer and salt water sanitation systems for Charlotte Amalie on St. Thomas and for Christiansted and Frederiksted on St. Croix. A modern highway system is under construction for all three islands.

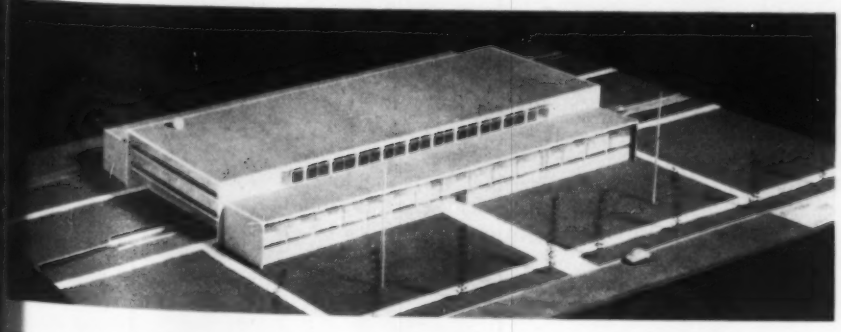
Increased National Guard Armory Needs Cited by Chief

APPROXIMATELY 1,500 NEW armories will
required to house the greatly increased
p basis of the new National Guard
ich, when organization is complete, will
ve a strength of about 683,000 men as
mpared with an average strength of
3,000 before World War II. This
nouncement was made by Maj. Gen.
nneth F. Cramer, chief of the National
ard Bureau, who added that the armory
rtage already has become a major factor
the continued growth of the National
ard. Definitive drawings, outline specifications and pictures of model armories for the National Guard have been completed by the Army Corps of Engineers, and are in process of distribution to the Adjutants General of the various states.

Four types of armories have been developed, which will house from one to ten units of company size, with cost estimates ranging from $444,000 to $1,827,000. All proposed armories are centered around a demonstration and assembly hall, with functional structures so designed that additions can be made readily.



AS PART OF ITS NEW $6,000,000 construction program, expanding National Guard will have four types of armories, housing from one to ten units of company size, and various appurtenant structures. Shown above is motor vehicle storage building for dead storage with alternate arrangement for minor repairs and administration. Construction costs will average $4 per sq ft. Model of proposed ten-unit armory, to be built at estimated cost of $1,827,000, is pictured below.



Building Methods Inadequate for Future War, A.G.C. Told

CONSTRUCTION METHODS THAT achieved such notable results in World War II would be inadequate for a future emergency, Rear Admiral J. J. Manning, M. ASCE, chief of the Navy Bureau of Yards and Docks, warned the 1,300 members of the Associated General Contractors of America in attendance at the 29th annual convention of the A.G.C. recently in Dallas, Tex. Admiral Manning asked for the cooperation of contractors and the A.G.C. in the Navy preparedness program.

Other speakers addressing the four-day meeting included Walker R. Young, M. ASCE, chief engineer, U.S. Bureau of Reclamation, Denver, Colo.; F. W. Parrott, retiring president of the A.G.C.; Charles H. Sells, New York State superintendent of public works; and J. T. Callaway, president of the American Road Builders Association.

Dwight W. Winkelman, head of D. W. Winkelman Co., Syracuse, N.Y., was installed as president of the A.G.C. for 1948. Other new officers are Adolph Teichert, Jr., vice-president, and William Muirhead, secretary-treasurer. George W. Koss, M. ASCE, of Des Moines, Iowa, is chairman of the Highway Contractors Division, and S. L. Fuller, M. ASCE, of Pittsburgh, Pa., chairman of the Heavy Construction and Railroad Contractors Division.

Steel Industry Expansion Plan to Meet Rising Consumer Needs

MORE IRON AND steel are being used by the people of this country today than ever before in its history, with a corresponding expansion and improvement program of steel companies involving record-breaking expenditures totaling nearly $1,700,000,000, according to figures just released by the American Iron and Steel Institute.

Total amount of iron and steel in use at the beginning of 1947, Institute figures show, was approximately 1,038,000,000 net tons, or 14,500 lb in use for every man, woman and child in this country. The per capita figure in 1900 was about 3,300 lb. Buildings, bridges, ships, automobiles, railroads and other heavy users of steel account for the greater part of the current figure.

Companies in the steel industry plan to spend an aggregate of $565,000,000 for new equipment and expansion this year, Institute figures show. Companies spent at least 10 percent more, or a total of about $496,-

000,000, in 1947 over the estimated $448,000,000 for that year. The $1,700,000,000 program raises to $3,805,000,000 the total amount of money spent and allocated since 1935 by steel companies to expand and improve their plants, an increase of 26 percent over the estimated net income of the entire industry in the period, 1935–1947.

Traffic Engineering Series Is Opened with Mid-West Meet

FIFTY ENGINEERS, PUBLIC works officials and other men interested in location, construction, maintenance and operation of streets and highways attended the first of a series of three-day traffic engineering conferences recently at the University of Minnesota. The conference was sponsored by the University's Center for Continuation Study in cooperation with the Minnesota Department of Highways, the League of Minnesota Muncipalities, the Institute of Traffic Engineers, and the Yale Bureau of Highway Traffic. Robert S. Holmes, Assoc. M. ASCE, executive secretary of the Institute of Traffic Engineers, led the opening-day panel discussion on accident record procedures and problems, parking, and traffic survey techniques.

Traffic engineering subjects discussed at the meeting included studies and surveys regulations, and design and planning. A second conference is planned for late June at the University of Missouri, with later ones at Los Angeles, Oregon State College and in Florida and Texas.

Member Named Head of Equipment Distributors

ALBERT F. GARLINGHOUSE, Assoc. M. ASCE, is the new president of the Associated Equipment Distributors, chosen at the group's 29th annual meeting recently in Chicago. He is a Los Angeles contractor.

Home builders in the United States have fought and will continue to oppose government control of housing, members attending the five-day convention were told by Edward R. Carr, president of the National Association of Home Builders. He said that home builders in this country have no intention of sharing the experience of builders in England and France, where government controls have killed the building business.

Gigantic construction jobs, highways, airports, dams and flood control, irrigation and soil conservation projects, could not have been accomplished for ten times present costs without the cost-cutting, man-hour-saving machinery designed by the construction equipment industry, J. T. Callaway, president of the American Road Builders Association, told the conference.

The construction industry can carry out a record dollar volume of construction activity under constantly improving conditions during 1948, unless the materials requirements of the European recovery program cause crippling shortages in this country, Dwight W. Winkelman, president of the Associated General Contractors of America, said in his address.

Sixth Edition of "Who's Who in Engineering" Is Available

WITH SOME 16,000 engineers represented, the sixth edition (1948) of *Who's Who in Engineering* is now off the press, with 12 percent greater coverage than the last edition, published in 1941.

As in previous editions, qualifications for inclusion were established by an advisory committee of the profession—in this instance, a committee of Engineers Joint Council. ASCE members represented on the committee on qualifications were Executive Secretary William N. Carey and T. Keith Legare, secretary of the National Council of State Boards of Engineering Examiners.

The volume, which sells for $15, may be obtained from the publishers, Lewis Historical Publishing Co., Inc., Eighth Avenue at 14th Street, New York 11, N.Y.

N.Y. Skyscraper Topped by 200-Ft Steel Tower

STEEL TELEVISION TOWER, 200 ft high, topped by 80-ft antenna, is being built atop 36-story skyscraper building in mid-town Manhattan. Tower is of special streamlined design to fit architecture of building, and top of antenna will be 754 ft above street. Project is being built for New York Daily News by Turner Construction Co., of New York, with Alexander D. Crosett & Associates serving as architects and engineers. Construction work includes building of additional two floors (indicated by radio station letters WPIX in photograph) on top of nine-story plant structure on east side of building to house television studios. Work is being speeded to meet early completion date.

Highway Administrators Are Held Responsible for Safety

HIGHWAY ADMINISTRATORS MUST accept it as their prime responsibility to develop a highway program which will bring to motorists the safety only modern highways can provide, Roy E. Jorgensen, M. ASCE, deputy highway commissioner and chief engineer of Connecticut, told the annual short course on roadside development at Columbus, Ohio, recently. It is their further responsibility, he said, to develop accident records in such shape that they can forecast the hazard reduction that will result from modernization of our highways.

"I think the road users of our states are entitled to know what ten million or 100 million in road improvements will mean in saved lives, the number of injuries eliminated, and property damage reduction," Mr. Jorgenson said.

Seek Technical Reading for Hospitalized Veterans

AN APPEAL FOR publications of a technical and specialized nature for men in veterans' hospitals in the Milwaukee area met with such success there recently that Samuel R. Snead, of the Engineers' Society of Milwaukee, has issued a nation-wide appeal for such contributions to local veterans' institutions.

While there is much so-called popular reading available, Mr. Snead indicated, many of the veterans are eager for more highly specialized material on engineering, economics, physics, chemistry, factory management and other material of a scientific or technical nature.

ASCE Men Prominent in Plan for Fall Hydraulics Meet

SOCIETY MEMBERS HELPING to make plans for the fourth annual meeting of the Conference on Industrial Hydraulics, October 20 and 21, at the Sheraton Hotel, Chicago, include Dr. V. L. Streeter, director of fluids research in the department of fundamental mechanics research at the Illinois Institute of Technology, chairman of the conference, and T. M. Niles.

Local Sections of the ASCE will cooperate with other engineering groups in planning the conference, which is sponsored by the Armour Research Foundation of the Illinois Institute of Technology and its graduate school.

W. E. Wrather New Head of Mining Engineering Group

W. E. WRATHER, Director of the U.S. Geological Survey, was inaugurated president of the American Institute of Mining and Metallurgical Engineers at the organization's 166th meeting, recently held in New York City and attended by more than 3,000 members. Mr. Wrather succeeds Clyde Williams, director of Battelle Memorial Institute, Columbus, Ohio, as president.

Announcement Made by Reclamation Bureau on New Western Projects

IN ITS MARCH 1 *Advance Construction Bulletin*, the Bureau of Reclamation indicates several large Western construction projects upon which work is about to begin. While the bulletin states that all information published is subject to revision, the data presented here will give an idea of the location, nature and size of proposed reclamation projects.

CANAL

Central Valley Project, California

Location: Near Tracy, Calif.
Work: Construction of earthwork, lining, and structures for 13.6 miles of Delta-Mendota Canal.

Excavation	5,000,000 cu yd
Concrete	112,700 cu yd
Furnishing and placing reinforcement steel	2,667,000 lb
Furnishing and installing 15 to 30-in. diameter concrete pipe	3,300 lin ft

Time Allowed for Completion: 750 days

PIPELINES AND STRUCTURES

Coachella Division, All-American Canal, California

Location: Near Indio, Calif.
Work: Construction of concrete pipelines and structures for Unit No. 4, Coachella Valley distribution system.

Furnishing and placing concrete pipe from 10 to 72 in. in diameter	240,000 lin ft
Pipe trench excavation	146,000 cu yd
Concrete in structures	440 cu yd

Time Allowed for Completion: 365 days.

LATERALS AND DRAINS

Klamath Project, Oregon-California

Location: Near Tule Lake, Calif.
Work: Construction of earthwork and structures for laterals and drains in Area A.

Excavation	298,500 cu yd
Concrete	120 cu yd
Rockfill	550 cu yd
Furnishing and placing 24 to 72-in. metal pipe	1,800 lin ft

Time Allowed for Completion: 300 days.

SIPHON

Missouri Basin Project, Nebraska

Location: Frenchman-Cambridge unit near Oxford, Nebr.
Work: Construction of approximately 2,500 ft of 63-in. monolithic or 60-in. precast concrete siphon for Cambridge Canal.
Time Allowed for Completion: 120 days.

Highway Builders Gather for Mutual Help Discussions

DEVELOPMENT AND USE of highway construction equipment and compaction of soils were chief subjects at a conference early this month at the Whitcomb Hotel, San Francisco. Sponsoring groups included technical committees of the Highway Research Board and the American Road Builders' Association, with H. F. Clemmer, M. ASCE, engineer of materials and tests for the District of Columbia, acting as general chairman of the sponsoring committees. Contractors, engineers and manufacturers discussed reduced construction costs, more satisfactory results for engineers' work, and curtailing of costly experimentation by manufacturers.

U.S. Public Health Service Seeking Sanitary Engineers

COMPETITIVE EXAMINATIONS FOR appointments in the U.S. Public Health Service regular corps in grades of assistant and senior assistant sanitary engineer will be held in June to fill approximately 15 appointments.

Assignments include general sanitary engineering, industrial hygiene, malaria and typhus control, milk and food sanitation and research, with appointees holding the rank of first lieutenant (assistant sanitary engineer) and captain (senior assistant). Entrance salaries in the two divisions are $3,811 and $4,351, respectively, for men with dependents. Promotions are at regular intervals, and retirement, medical care, and annual leave provisions are comparable with those in other branches of the government service.

Applicants must be citizens of the United States, have engineering degrees from recognized schools and have experience commensurate with the position for which they apply. Application forms and additional information may be had from the Surgeon General, U.S. Public Health Service, Washington 25, D.C.

Program for Missouri River Basin Is Now Available

A SIX-YEAR PROGRAM for development of land and water resources in the Missouri River basin under the Pick-Sloan Plan, recently adopted by the Missouri Basin Inter-Agency Committee, has been issued by the War Department. The program constitutes a master blueprint for guidance of federal and state agencies concerned with maximum development of flood control, irrigation, power and navigation and other benefits of the comprehensive plan for the basin authorized by Congress.

A summary of construction schedules for the various states and federal agencies included in the plan is available. Inquiries should be addressed to the Missouri River Division, U.S. Department of War, Omaha, Nebr.

British Create New River to Improve Flood Control

DESIGNED to protect the fertile and low-lying agricultural area of the Fens, a marshy region in Lincolnshire, England, a new flood-prevention plan recently was initiated in Great Britain. Under the plan, a new river 31 miles long will be created to carry off spring rains into the North Sea. The Fens region was first drained scientifically 300 years ago.

The region suffered severe inundations last year, and 7 percent of the Fens area was flooded. The level of the land is dropping at the rate of one inch a year so that foundations will not support any greater weight, creating need for an alternative method of keeping down the water level. Creation of the new river will reduce the amount of water to be drained from the area and that to be carried off will be provided a quicker outlet to the sea.

Accident Costs Are High in Detroit, Survey Shows

A STUDY OF the Detroit, Mich., accident situation to determine costs of automobile repairs and increased doctor and hospital fees from such accidents will be made this summer. The survey will include a personal canvass of persons involved, with direct interviews to determine what accidents cost them.

Figures now available indicate that traffic accidents in Detroit are costing the persons involved nearly 10 million dollars a year in direct costs, according to a study made by the accident-prevention department of the Association of Casualty and Surety companies. Records indicate a total of 186 persons killed in the 51,048 accidents in Detroit last year. Total costs revealed in the study show that accidents are taking $788,340 a month from Detroit motorists.

Producers' Group Head Lauds Building Industry Record

A TENDENCY TO judge the private building industry by what it has not been able to accomplish, rather than by the outstanding record it has made in the face of unprecedented handicaps, must be corrected, David S. Miller, president of the Producers' Council, said recently in a talk before the National Concrete Masonry Association. Mr. Miller announced a forthcoming series of economic studies and other media by the Construction Industry Information Committee through which the story of the industry's progress will be told.

"Although only a part of the huge pent-up need for new construction has been met in the 30 months which have elapsed since the war, the volume of building has accelerated at an amazing rate following the end of the wartime shutdown," Mr. Miller said. "The amount of new construction would have been even greater had not vast quantities of materials been used to repair and improve existing buildings."

ASCE Men Are Honored with Water Works Posts, Awards

SEVERAL ASCE MEMBERS were honored through election to office, to honorary membership, or with awards for outstanding work at the recent board of directors meeting of the American Water Works Association in New York City.

Linn H. Enslow, Assoc. M. ASCE, of New York, is new president of the association, succeeding N. T. Veatch, M. ASCE, of Kansas City, Mo. William W. Brush, M. ASCE, was reelected treasurer. Honorary memberships were conferred upon ASCE members Louis R. Howson, of Chicago and Abel Wolman, of Baltimore.

Linn H. Enslow

Melvin P. Hatcher, M. ASCE, director of water, Kansas City, Mo., was awarded the John M. Goodell Prize for his paper on "Water Works Rules and Regulations." For his highly effective direction of the work of a special committee of the water purification division which resulted in a speedy completion of texts for the forthcoming revised edition of the "Manual of Water Quality and Treatment," A. Clinton Decker, M. ASCE, sanitary engineer of the Tennessee Coal Iron & Railway Co., Birmingham, Ala., was presented with the John M. Diven Medal.

The association's spring conference will convene May 3 at Atlantic City, N.J., for a four and one-half day meeting.

Engineers' Starting Pay More than Doubled in Last Decade

AVERAGE STARTING SALARIES for the past semester's engineering graduates from the Illinois Institute of Technology, Chicago, range between $260 and $275 monthly, an announcement from the office of placements at the institution indicates. Top salary among the graduates is $400 paid to one engineering graduate, with two others receiving $350 each per month. The average starting salaries for June 1947 graduates from the institute were $250, while a year ago graduates averaged $231 a month on their first job. Ten years ago normal starting pay for engineers was $100 a month, the survey shows.

Innovations in Skyscraper Construction Are Predicted

SKYSCRAPERS OF THE future will incorporate many innovations in the use of light steel construction, said B. L. Wood, consulting engineer for the American Iron and Steel Institute, in addressing a recent meeting of the American Institute of Architects. Mr. Wood predicted that welding will be widely used in future skyscraper construction, with resultant economy.

Light steel panels will be extensively employed for secondary floor construction, he stated, citing their recent use in the 30-story Mercantile Bank Building in Dallas, Tex., and the 28-story John Hancock Insurance Building in Boston. He also predicted that exterior walls in commercial buildings will be formed of light steel panels, thus reducing substantially the weight to be supported by the building foundation and framing—important cost factors. Mr. Wood pointed out that the New York City Building Code was recently revised to facilitate use of such metal panels.

Three Airport Engineers Are Needed by California Body

APPOINTMENTS TO THREE recently authorized positions for qualified airport engineers in California on a temporary basis, subject to later qualification of appointees in a state civil service examination, will be made shortly. Positions include those of supervising airport engineer, airport design engineer, and airport planning engineer.

Minimum requirements for all positions include California registration as a civil engineer prior to appointment, education equivalent to graduation from college with a major in engineering, and experience ranging from three to five years. California residence is not required.

Construction Superintendents Announce Officers for 1948

OFFICERS WERE announced at the recent annual meeting of the Society of Construction Superintendents of New York as follows: A. B. Fleck, president; George Martin, vice-president; and Sidney Millsten, secretary.

Guests at the annual dinner, at which Myron Matthews was master of ceremonies, included: Arthur Benline, Manhattan Department of Housing and Buildings superintendent, and Joseph Herman, Edward Crinnion and Benjamin Saltzman, who hold similar posts in Staten Island, the Bronx and Brooklyn, respectively.

Joint Sewerage Authority Program Headed by Member

A SEWERAGE AUTHORITY to administer and finance a $2,500,000 pollution abatement project for the city of Linden and the borough of Roselle, N.J., has been formed, with Franklin Hudson, M. ASCE, as chairman. Alexander Potter Associates, New York City Consulting Engineers, made the study and subsequent recommendation for the project. Present population of the communities is about 50,000, but the area is highly industrialized and daily waste is equivalent to a population of 235,000.

Engineering Vacancies Exist on Federal and State Staffs

ASCE HEADQUARTERS IS in constant receipt of notifications from federal, state, county and municipal agencies seeking qualified engineering personnel. Unfortunately early expiration dates for filing applications and taking examinations for many of these positions make it impossible to list them in CIVIL ENGINEERING. However, members interested in this type of employment are advised to keep in touch with local offices of the various agencies.

Meetings and Conferences

American Institute of Electrical Engineers. Inspection tours to the Firestone Tire and Rubber Co., the Iowa Power and Light Co., and other industrial centers comprise part of the program for the Great Lakes District meeting of the AIEE, at Des Moines, Iowa, April 1–3. Headquarters will be the Hotel Fort Des Moines. A meeting of the Northeastern District is scheduled for April 28–30 at New Haven, Conn.

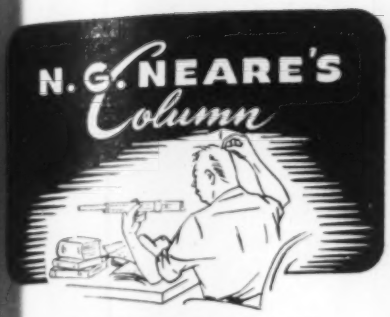
American Water Works Association. A series of panel discussions will be introduced for the first time at the American Water Works Association Conference, to be held at the Atlantic City Auditorium, Atlantic City, N.J., May 3–7. Panel and round table conferences will be held mornings, general sessions in the afternoon.

Citizens Conference on City Planning. Better communities for New York City is the theme of a one-day working conference for citizens and representatives of civic and business organizations of the five boroughs of New York City, to be held at the Hotel Roosevelt on April 8. Sponsoring groups include the Metropolitan Section of the ASCE, the New York Chapter of the American Institute of Architects, and the Regional Plan Association.

Illinois Conference on Surveying and Mapping. Sponsoring groups for the sixth annual Illinois Conference on Surveying and Mapping, to be held at Navy Pier, Chicago, May 7 and 8, are the civil engineering department and the division of engineering sciences, Navy Pier Branch, of the University of Illinois and the Illinois Institute of Technology.

Inter-Professions Conference on Education for Professional Responsibility. Problems of professional education in the five major fields of engineering, law, medicine, business and religion will be considered at this meeting, to be held at Buck Hill Falls, Pa., April 12–14.

Southern Machinery and Metals Exposition, Inc. Demonstrations in metal cutting will be a feature of the Southern Machinery and Metals Exposition, scheduled for Atlanta, Ga., April 5–9. Sessions will be at the Atlanta Municipal Auditorium.



R. Robinson Rowe, M. ASCE

"I WAS INTRIGUED by your holiday greeting problem, Noah, but not enuf to solve it," said Ken Bridgewater. "Frankly, weren't you ridiculing the custom? And didn't your statistics exclude the good citizens who sent Xmas cards to a wide circle of friends and then found themselves newly added to the wider circles of others?"

"That would be calling the kettle black, Ken. If I simplified the statistics, it was to simplify a very complicated problem so that maybe Jo Kerr could try to solve it."

"Which I did, Professor, because you made it too, too simple. Letting the population of citizens be P, each had $0.01P$ acquaintances, and the number of cards would be:

$$C = 0.29P \times 0.10 \times 0.01P + 0.71P \times 0.07 \times 0.01P = 0.000787P^2$$

Then, since the postage was about $200,000,

$$0.03C = 0.00002361P^2 \doteq * 200{,}000$$

from which I found $P = 92{,}000$, $C = 6{,}661{,}168$ and the postage was $199,835.04."

"I think Joe forgot to count himself out," said Cal Klater. Each citizen had only $P-1$ fellow citizens, and so:

$$C = 0.000787P(P-1)$$

For the averages to be exact, $P(P-1)$ must have the factor 1,000,000, but if either P or $P-1$ is 1,000,000, the postage at the minimum of $1^1/_2$ cents would exceed $11,000,000.

"Since P and $P-1$ are relatively prime and $1{,}000{,}000 = 2^6 \times 5^6$, one must contain the factor 64 and the other 15,625. If we let $P = 64x$ and $P-1 = 15{,}625y$, or vice versa, the two possibilities are expressed:

$$64x - 15{,}625y \pm 1 = 0$$

"The smallest solution in integers is $P = 109{,}376$, which means $C = 9{,}414{,}881$, more than half of which bore $1^1/_2$-cent stamps."

"Nice work, Cal, and I suppose you could have added that the next smallest solution is the complement $P = 890{,}625$, which would require far too much postage. It may also be of interest to note the general solution for $P(P-1) = m(10^n)$ up to $n = 20$ can be expressed by the number 92,256,259,918,212,890,625 and its complement. The last n digits of the two numbers will give the two least solutions and by taking more digits we get other solutions in which m is also divisible by 10. For example, for $n = 2$, $25 \times 24 = 600$ and $76 \times 75 = 5{,}700$.

"For our new problem, we are indebted to California's centennial, which has been reviving many legends of forthright justice in the placer camps of 100 years ago. One of the most infamous was the portable nexecutioner of Amaderas County, shown diagrammatically in Fig. 1. Dismantled, the five members were packed to the scene of a trial where 6 bolts restored its ugly utility in anticipation of the inevitable verdict.

"Originally the posts were 17 ft long, matching the cap, but later the height was reduced to 11 ft by halving the knee height. This tripled the horizontal kick H at the base of each post due to the live-or-dead-plus-impact load in the sling. You'll enjoy computing I for the cap if you don't try to use irrelevant data. According to the legend, the itinerant nexecutioner was abandoned when business warranted a permanent structure in each camp."

[Cal Klater remains anonymous this month. Walter Harold Johnson called attention to the structural interest of the legendary frame.]

* $\doteq$ means "approximately equal to."

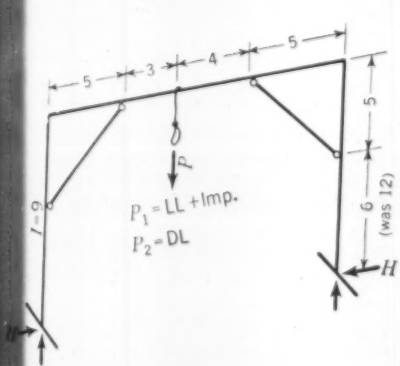


Fig. 1. The Amaderas Nexecutioner.

AN INSTITUTE FOR effective teaching has been established at the University of Detroit college of engineering to help faculty members give maximum instruction in the classroom. There will be eight sessions of the institute, conducted monthly with four lectures and four discussion groups. Subjects for the programs include an Introduction to Effective Teaching, Effective Teaching, the Harassed Teacher, and Teaching as an Art. Jasper Gerardi, engineering faculty member, and Thomas C. Hanson, head of the department of engineering, now on leave, will be among the speakers. Both are ASCE members.

* * *

ALUMNI OF GEORGIA School of Technology have voted three to one to change the name of the institution to Georgia Institute of Technology, figures just released by the Georgia Tech National Alumni Association indicate. A total of 5,113 alumni favored the change, as against 1,495 voting to retain the present name. Faculty members voted 145 to 130 in favor of the change. Results of the balloting will be presented to the Board of Regents for action.

* * *

TWO SCHOLARSHIP FUND gifts have been received by the college of engineering at the University of Iowa. Income from one of the gifts, common stock valued at about $16,000 from Fred Stebler, Riverside, Calif., will be awarded annually to a needy and worthy engineering student. The second gift, from Nathan Wohlfeld, Assoc. M. ASCE, is a $1,000 addition to the B. J. Lambert scholarship fund. Mr. Lambert, M. ASCE, is head of the department of civil engineering at the university. Scholarships in his honor were established in 1944 through gifts from alumni, students and faculty.

THORNDIKE SAVILLE, former ASCE director, dean of the New York University College of Engineering, has announced that the college will maintain a cosmic ray laboratory atop Mount Evans, Colo., in cooperation with four other universities. The laboratory, Dean Saville said, will be the "highest" building of its kind ever constructed. Mount Evans is 14,260 ft high. The laboratory, to be known as the Inter-University High Altitude Laboratory, will be maintained jointly with Massachusetts Institute of Technology, Cornell University, the University of Chicago, and Denver University.

* * *

EIGHT ENGINEERS FROM industrial fields have been appointed as adjunct professors in five fields of graduate study at Stevens Institute of Technology, Hoboken, N.J., with a ninth named visiting professor. All of the men formerly were lecturers in the graduate school. Their new appointments are based on the belief that the inclusion in the faculty of such specialists with wide industrial experience will be a source of stimulation to the programs of instruction and research in progress.

* * *

EMPHASIS WAS PLACED on the problems and methods used by sanitary engineers outside the United States in promoting safe water supplies and proper sewage disposal at a joint conference recently at the Duke University College of Engineering. Participating were representatives of the three North Carolina institutions at which sanitary engineering is taught. Engineers from Colombia, Brazil, Italy and the Philippines took part, together with sanitary engineers of this country engaged in consulting, construction and governmental work. Dean W. H. Hall, M. ASCE, of the Duke engineering school, and Prof. H. G. Baity, M. ASCE, of the University of North Carolina School of Engineering, were among those on the program committee working in close cooperation with the Inter-American Sanitary Engineering Association, Washington, D.C.

A STUDY IS being made under auspices of the American Society for Engineering Education to determine the physical development of engineering facilities in the United States. Forms have been distributed to administrative officers who, it is felt, are confronted with the problem of procuring funds for new buildings and who will be greatly helped by an indication as to what engineering colleges in the country have done and are contemplating doing to meet the need for new buildings.

Engineering Enrollment Is Doubled in U.S. Colleges

ENGINEERING ENROLLMENT IN United States colleges has more than doubled in the past year over the 1940–1941 figure, the final prewar year in which college enrollments were normal. The total enrollment of engineering students this year, according to the January issue of the *Journal of Engineering Education*, publication of the American Society for Engineering Education, is 244,390, as compared with 113,497 in the 1940–1941 school year. Of these 29,531 are undergraduate civil engineering students. The percentage of engineering students to the total college enrollment in the United States jumped to 10.5 percent this year, compared with 7.6 percent in 1940–1941.

A survey just completed by the ASEE on the number of full-time students enrolled in the 143 accredited engineering schools and colleges in this country shows the following enrollment among the ten schools with the highest number of engineering students: Purdue University, 8,791; Illinois Institute of Technology, 7,150; University of Illinois, 6,086; Georgia School of Technology, 5,260; City College of New York, 5,013; University of Minnesota, 4,912; University of Michigan, 4,396; Massachusetts Institute of Technology, 4,377; Texas A. & M. College, 4,273; Ohio State University, 4,247.

New Group Is Founded to Promote Science at College

A NEW NATIONAL scientific organization, designed primarily for industry, has been established, with headquarters at Yale University. Affiliated with and sponsored by Sigma Xi, national honorary scientific fraternity, the new organization, known as the Scientific Research Society of America, has as its aim the encouragement and promotion of scientific research, with chapters in important industrial laboratories to encourage and assist research scientists.

Plans of the new group call for establishment of local branches in research laboratories of many leading industrial plants and technical schools, whereas Sigma Xi chapters are established only at educational institutions. Basic requirement for membership in both organizations is noteworthy achievement as an original investigator in some branch of pure or applied science.

Wool Gatherings by WOOLLEY

IN 1939 our chemical exports amounted to $164,000,000. In the last year they had increased to $500,000,000.

A REVOLUTIONARY new steam turbine drive on steam locomotives gives smoother engine operation and 25 percent more power.

PROJECTILES SMASHING through armor plate are now photographed with an X-ray tube that takes a picture in $^1/_{1,000,000}$th of a second.

NEARLY 40,000 engineers and chemists are employed in Chicago and northern Illinois assuring industry of the technical "know-how" for every industrial problem and operation.

UNDERSEA MINING OF COAL is being carried on off the west coast of Japan. An estimated 400,000,000 tons of coal is buried under the ocean floor in the Kokura field.

AN IRRIGATION PROJECT in the Province of Madras is expected to add 200,000,000 acres to India's farm lands.

IN 1931 TIMKEN BUILT the first roller bearing steam locomotive. Today nearly all new locomotives are on roller bearings.

A NEW CHART published by the Geological Survey shows geology along Alabama highways. Charts of this type will find many uses.

FOR SOME 700 YEARS all that was known of "Magnetism" was that lodestone will line up north and south in the earth's magnetic field.

IN 1945 RAILROADS operated trains 91,826,353,000 miles.

THE 17 HYDROELECTRIC units of Grand Coulee Dam will have a total capacity of 2,197,600 hp.

IN BABYLONIA about 1100 B.C., water wheels were invented and four centuries later Sennacherib brought in the shadoof from Egypt.

DURING NERO'S TIME there were nine aqueducts in operation supplying 200,000,000 gal of water per day to the city of Rome.

CALIFORNIA has initiated a program of a three-year survey of its water resources to cost about $500,000.

PEAK LOADS ON THE principal electric utility systems of the country totaled more than 43,700,000 kw in September 1947. This was the highest total on record.

IN 1696 New York City made its first appropriation for street cleaning—£20.

New Publications

Hydroelectric Development. A review of hydroelectric progress in Canada during 1947 has been issued by the Dominion Water and Power Bureau, Department of Mines and Resources, as part of its regular annual survey of resources. Inquiries should be addressed to the Dominion Water and Power Bureau, Ottawa, Canada.

Sound Insulation. Supplement No. 2 to National Bureau of Standards Report BMS 17, *Sound Insulation of Wall and Floor Constructions*, is now available. The present 15-page supplement contains the results of measurements on all constructions tested since the issuance of the original report in 1939 and the first supplement in 1940. BMS Report 17 and Supplements 1 and 2 may be purchased from the Superintendent of Documents, Washington 25, D.C., at a cost per copy of 20 cents, 5 cents and 10 cents, respectively.

Housing Statistics. To promote broader understanding and coordination of housing information, the Housing and Home Finance Agency has published a 179-page *Handbook of Housing Statistics*. Copies of the handbook, which is drawn from more than 30 sources, including both government and private agencies, are available from the Superintendent of Documents, Government Printing Office, Washington, D.C., at a cost of $1 each.

Road Research. Variations in the quality of concrete as produced in practice are discussed in Road Note No. 3 of the British Department of Scientific and Industrial Research, entitled "Effect of Batching Errors on the Uniformity of Concrete." Another recent release of the department, dealing with the "Design of Concrete Mixes," describes a method of determining what concrete mix properties are required to produce, with given materials and under given work conditions, a concrete of the designed minimum strength. Both may be obtained from H. M. Stationery Office, Kingsway, London, W.C. 2, England, at a cost of 3d. each.

Federal Works. Activities and accomplishments of the Federal Works Agency for the fiscal year ending June 30, 1947, are summarized in the Eighth Annual Report of the Agency. Copies of the 47-page report are for sale by the Superintendent of Documents, Washington, D.C., at a cost of 20 cents.

Highway Safety. To better traffic conditions and increase highway safety, the Eno Foundation for Traffic Control (Saugatuck, Conn.) is distributing free of charge a 187-page manual, *Use of Traffic Accident Records*. The manual has been compiled by the Yale University Committee on Uses of Developed Information of the National Conference on Traffic Accident Statistics after seven years of preparation. The project was headed by Wilbur S. Smith, Assoc. M. ASCE, associate director of the Yale Bureau of Highway Traffic.

Highway Research. Synopses of the papers and reports, given at the 27th annual

meeting of the Highway Research Board, constitute the December 1947 issue of *Highway Research Abstracts*. Single copies of the publication may be obtained from the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C., at a cost of 75 cents. Subscription rates are $2.25 a year.

Dwelling Construction. Savings that can be effected through the use of preassembled wood roof trusses in construction of small houses are cited with specific examples in the February issue of *HHFA Technical Bulletin*, published by the technical staff of the Housing and Home Finance Agency. Inquiries should be addressed to the Office of the Administrator, Housing and Home Finance Agency, Washington, D.C.

Railroad Construction. In a bulletin, entitled "Some Railroad Problems Past and Present," the Connecticut Society of Civil Engineers reprints a talk by Sidney Withington, chief electrical engineer for the New York, New Haven & Hartford Railroad, presented at its 63rd annual meeting.

Geological Survey Maps and Reports. A number of new maps and reports have been released by the U.S. Geological Survey. Unless otherwise noted, they may be obtained from the Director, U.S. Geological Survey, Washington 25, D.C. The list of new publications includes:

Translations of two Russian papers on electrical soil stabilization—"Electrochemical Stabilization of Clayey Ground" and "Electrochemical Stabilization as Means of Preventing Ground Failure in Railroads"—may be obtained free as long as the supply lasts.

A preliminary map showing construction materials in the southern half of Williams County, North Dakota, is in open file in the Survey offices in Washington and in the office of the State Geologist, University of North Dakota, Grand Forks, N.Dak.

Missouri Basin Studies No. 12, entitled "Construction Materials and Non-Metallic Mineral Resources of South Dakota," may be purchased for 60 cents. Also available from the office of the South Dakota State Geological Survey, Vermillion, S.Dak.

Memoranda on the possibility of developing ground-water supplies for the Alamogordo Army Base and the White Sands Proving Ground, New Mexico, by R. C. Murray, are in open file in the Survey offices in Washington and in the office of the State Engineer, Santa Fe, N.Mex.

"Ground-Water Resources of Kansas," by V. C. Fishel, is in open file in the Survey offices in Washington and at the University of Kansas, Lawrence, Kans., and in the office of the State Board of Agriculture, Topeka, Kans.

"Methods of Collection and Development of Ground Water," by J. H. Adamson, Jr., is in open file at the State Department of Internal Affairs, Harrisburg, Pa., and at Survey offices in Philadelphia, Pittsburgh, and Washington.

Missouri River Basin. The huge flood control and river development program of the Army Corps of Engineers in the Missouri River Basin has been described in a 23-page illustrated pamphlet prepared by the Missouri River Division Office of the War Department. The pamphlet, which includes information on authorized dam and reservoir projects, river channel improvements, and levee and floodwall work, may be obtained from the Missouri River Division of the War Department at Omaha, Nebr. An early revision of maps, to show the new reservoir plan for the Osage Basin in Missouri, will be made in the pamphlet soon.

Applied Mechanics. To meet the need for a comprehensive review of current literature in the field of applied mechanics, the American Society of Mechanical Engineers has launched a monthly scientific journal entitled *Applied Mechanics Reviews*. Reviews, to be prepared by experts who will cover the output of some 500 magazines here and abroad, will cover theoretical and experimental papers on solid mechanics, fluid mechanics, thermodynamics, and heat transfer and applications of these subjects to geophysics, soil mechanics and other fields. Subscriptions are $12.50 annually, with a special price of $9 to technical society members. Checks should be sent to the ASME Publication-Sales Department, 29 West 39th Street, New York 18, N.Y.

Construction Materials Data. Detailed statistical information on selected construction materials is being issued monthly by the Construction Division of the Department of Commerce in a supplement, entitled *Construction Materials Data*. The series of supplements, started in February 1948 with an issue on cement, will be reprinted in one volume at the end of the year. Inquiries should be addressed to the Construction Division of the Department of Commerce, Washington, D.C.

Water Power, Sweden. Power Supply in Sweden is summarized in a 32-page illustrated review, issued by the State Power Board in cooperation with the Swedish Association of Electricity Supply Undertakings and the Swedish Water Power Association. The review, which is printed in English, may be obtained from the Swedish Water Power Association, 16 Norrlandsgatan, Stockholm 7, Sweden.

Airport Financing. Engineering and administrative aspects of airports will be discussed in a new monthly release of the American Road Builders Association, entitled *Out at the Airport*. The March issue deals with federal financing of airports. Inquiries should be addressed to the American Road Builders Association, International Building, Washington 4, D.C.

Maps. A 57- by 35-in. general reference map of the world, prepared for the State Department by the American Geographical Society, is available at a cost of $2.50 upon application to the American Geographical Society, Broadway at 156th Street, New York 32, N.Y. International boundaries and sovereignty are shown as far as possible in accordance with the official United States viewpoint and include such recent revisions as the partition of India. Cities and towns are classified according to population. The map is made on a modified Mercator projection, with an equatorial scale of 1:30,000,000.

Traffic Studies. A check list that will be helpful to municipal officials in appraising the traffic situation in their cities is a feature of *Making Better Use of Today's Streets*, a 44-page illustrated booklet, which is offered at cost by the Chamber of Commerce of the United States, Washington 6, D.C. There is a graduated scale of prices, ranging from 35 cents for single copies to 25 cents a copy for lots of 1,000 and over.

Census Publications. Bureau of the Census publications for the period, January to September 1947, are indexed in a 163-page *Catalog and Subject Guide*, recently issued by the Department of Commerce. Inquiries should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

Anniversary Brochure. To celebrate the fortieth anniversary of its organization, the Cleveland firm of Wilbur Watson Associates has issued a 28-page illustrated brochure summarizing some of its most important engineering achievements. The firm was founded in 1907 by Wilbur J. Watson, M. ASCE, who died in 1939.

Philadelphia City Planning Commission Publishes Improvement Program Report

A BROAD PROGRAM of public improvements for Philadelphia, calling for expenditure of $332,792,789 over a six-year period, is detailed by the City Planning Commission in a report entitled *Recommended Program of Public Improvements, 1948–1953*. The report, fourth in an annual series, anticipates an expenditure of $72,677,609 for 1948.

More than 40 percent of total scheduled expenditures will be for rehabilitation and extension of the water system, construction of sewers and sewage-treatment works, and improvement of drainage conditions and of facilities for the collection and disposal of refuse. Development of highways and other transportation facilities constitutes another main objective, with almost $75,000,000 apportioned for restoration of city and city-state highways and for restoring and constructing city arterial highways and bridges.

Cost of development of the Southwest Airport and of partial development of the Northeast Airport and of other transit facilities is estimated at $60,712,000. Expansion of port facilities and a comprehensive building program, including construction of health, welfare, educational, recreational and other public facilities, are other important recommendations.

Established in 1942, the Philadelphia City Planning Commission is headed by Edward Hopkinson, Jr. ASCE members on the Commission include Thomas Buckley, director of public works, and Lawrence Costello, chief engineer, Philadelphia Department of City Transit. Robert B. Mitchell is executive director of the Commission, and Charles A. Howland, Assoc. M. ASCE, chief of the Division of Projects.

NEWS OF Engineers

G. H. Kevan recently became affiliated with the Kansas City, Mo., engineering firm of Harrington & Cortelyou. He had been associated previously with the Kansas State Highway Commission at Topeka, Kans.

Rear Admiral William H. Smith, has retired as director of the Atlantic division of the Navy Bureau of Yards and Docks, New York, after 30 years in the Navy Civil Engineer Corps. He has taken a position as chief engineer for Palmer & Baker, Inc., consulting engineers of Mobile, Ala.

E. O. Sweetser, after 42 years as a member of the faculty at Washington University, including 14 years as head of the department of civil engineering, has been relieved at his own request of further administrative duties. He is now the William Palm professor of civil engineering. **J. W. Hubler,** a member of the faculty since 1942, succeeds Professor Sweetser as head of the civil engineering department.

W. K. Dinklage, formerly division engineer with the Kansas State Highway Department, has been made assistant engineer of maintenance for the department.

Col. Herbert S. Crocker, Past-President and Honorary Member of the Society, has retired from the Denver, Colo., engineering firm of Crocker & Ryan which he headed.

Herbert S. Crocker

Widely known for his work in transportation structures, among them many of the most important in his home city as well as in Chicago and Salt Lake City, Colonel Crocker served as President of ASCE in 1932. He was Director from 1915–1917, Acting Secretary in 1920, Vice-President in 1919–1920, and was made an Honorary Member in 1939. While a member of the Denver Board of Water Commissioners, Colonel Crocker served as consulting engineer in charge of the city's $10,000,000 transmountain diversion project. Colonel Crocker's son, **Forrest S. Crocker,** and **Alfred J. Ryan,** his partner, will continue the firm's engineering practice.

M. J. Shelton recently was named representative for the La Mesa, Lemon Grove and Spring Valley (Calif.) Irrigation District of the San Diego County Water Authority. Mr. Shelton is assistant manager and engineer of the irrigation district.

Robert J. Allen has been appointed to the staff of the National Conservation Bureau, accident prevention division of the Association of Casualty and Surety Companies, with headquarters in New York City.

Nomer Gray is now associated with Walter Kidde Constructors, Inc., New York City, as development engineer. He formerly was with Ammann and Whitney of New York City, representing the firm on a $3,000,000 hangar, office and shop building for American Airlines.

Theodore Belzner was presented with a service pin recently in token of his long service with the New York City Department of Public Works as inspector of steel and bridge inspector in charge, Brooklyn Bridge. Presentation was made by **Commissioner Frederick H. Zurmuhlen,** of the Department of Public Works.

George M. Stiers, for the past two years in charge of construction of the Canton Dam, Canton, Okla., for the C. F. Lytle Co. and Amis Construction Co., is now in charge of construction of the Medicine Creek Dam, Cambridge, Nebr., for the same group.

John F. L. Bate has been appointed temporary port director at San Diego, Calif. He has been an engineer in the harbor department of that city for the past year and was employed previously by the San Diego Unified School District as resident engineer inspector on the construction of school buildings.

Albert D. M. Lewis, field engineer for the Gulf Oil Corp., Pittsburgh, is engaged on new construction work for the Cincinnati, Ohio, refinery of the Gulf Refining Co.

L. A. Lovell has joined the staff of the International Engineering Co., Inc., at Denver, Colo., as design engineer. He had been connected with Parsons, Brinckerhoff, Hogan & Macdonald, New York City, since 1939, working in New York and in South America.

James A. Riviere, until recently division engineer for the Florida Road Department, has organized the Jarco Corp. at Orlando, Fla., for general contracting and engineering, including drainage, grading, road work and building.

Sol Pincus has opened offices at 11 Park Place, New York City, for the practice of sanitary engineering. He was with the U.S. Public Health Service for eight years and deputy commissioner and senior sanitary engineer for the New York City Department of Health for the past twelve years.

Ralph H. Baker, Jr., and **John S. Telfair, Jr.,** have recently become affiliated with the Division of Water Supplies, Florida State Board of Health. Mr. Baker is in charge of investigation of plans for new water supply construction and supervision of public bathing places and common carrier watering points. Mr. Telfair will represent the Board in a cooperative survey of conservation and pollution of the state's water resources. Both formerly were in the Army Corps of Engineers.

Charles A. Lee has joined the staff of the research and development laboratories of the Kimberly-Clark Corp., Neenah, Wis. He formerly was employed by the Navy at the David Taylor Model Basin, Carderock, Md., where he was civilian chief of the hydraulics section of the Hydromechanics Division.

W. F. Tueting, Jr., lieutenant in the Navy Civil Engineer Corps, will assume new duties May 1 as public works officer for the Greenland group and as officer-in-charge of a construction battalion detachment. He has been public works officer at the naval air station at El Centro, Calif.

Grover E. Rickard, formerly superintendent of water and sewage treatment at Oneonta, N.Y., is newly appointed superintendent of the Bureau of Water, Binghamton, N.Y. He succeeds **S. P. Carman** who has opened a consulting engineering office in Binghamton.

Robert F. Blanks, chief of research and geology for the Bureau of Reclamation, Denver, Colo., was recently elected president of the American Concrete Institute, succeeding **Stanton Walker,** director of engineering for the National Sand and Gravel Association, Washington, D.C. Mr. Blanks has been with the chief engineer's staff of the Bureau of Reclamation in Denver for the past 18 years. The engineering and geological laboratory under his direction has become one of the largest of its kind in the world. He was recently co-recipient with **Harmon S. Meissner** of the Society's Thomas Fitch Rowland Prize. Active in international professional affairs, Mr. Blanks has served on subcommittees of the World Power Conference and the International Commission on Large Dams.

Robert F. Blanks

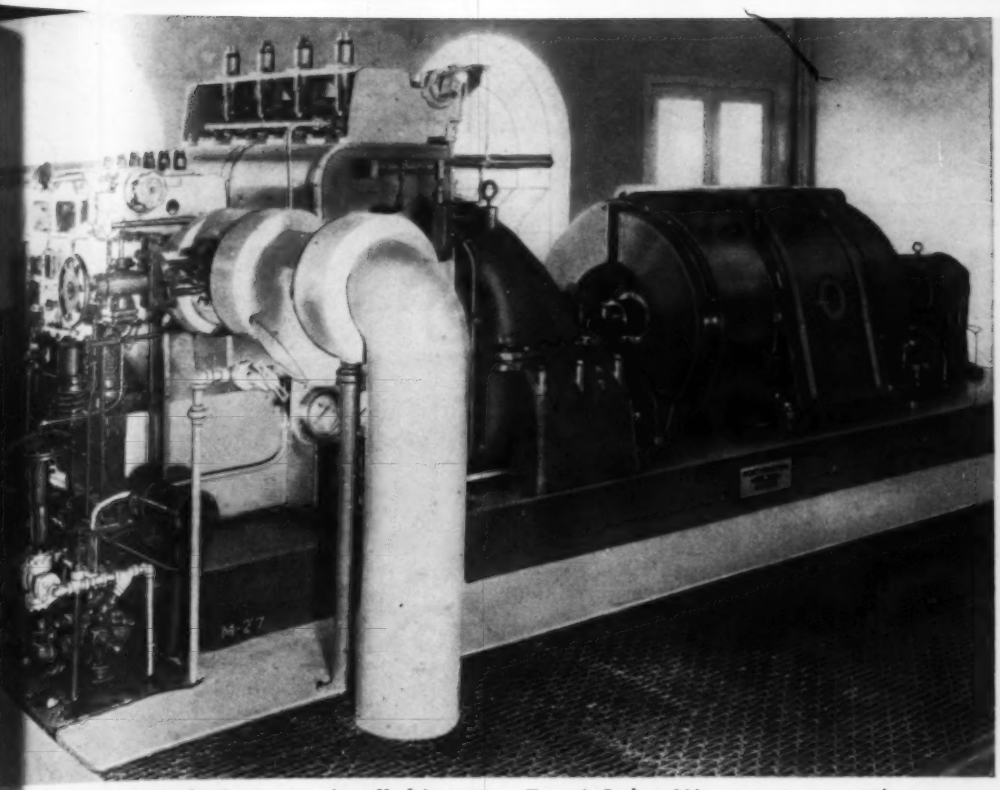
H. H. Hester, city street superintendent of Fort Worth, Tex., has been appointed state chairman of the American Public Works Association.

Alfred Mullikin is now sanitary engineer for the Headquarters of the Sixth Army, Presidio of San Francisco, Calif. He was for the past eight years civil engineer for the Federal Public Housing Authority.

Ralph L. Parshall retired from the U.S. Department of Agriculture recently after 35 years of service as an irrigation engineer. At the time of his resignation he was senior irrigation engineer of the division of irrigation, Soil Conservation Service. Mr. Parshall has done outstanding work on removal of silt from canals, return flow to streams, consumptive use of water, and water stage recording instruments. He began the snow survey and irrigation water supply forecasting project in the Rocky Mountain area and supervised the program until his retirement. He also made the economic study for determining the feasibility of the Colorado-Big Thompson Project, which is now being built by the Bureau of Reclamation.

Joseph M. Werblow has resigned as construction engineer with the Rheinstein Construction Co., Inc., of New York City, to accept a similar position with the Adirondack Construction Co., at Glens Falls, N.Y.

(*Continued on page 70*)



4000 kw Worthington Turbo-Generator—installed in 1937 at Detroit Lakes, Minnesota, power station

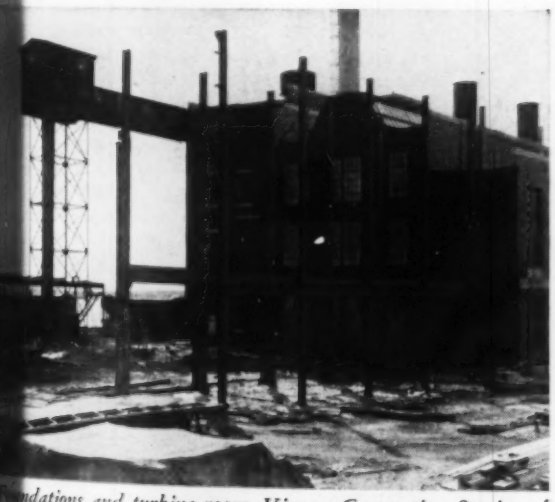
4000 kw More for Detroit Lakes

The City of Detroit Lakes, a bustling Minnesota resort center, has long taken pride in its municipally owned power plant. Through careful planning and good management, the plant has prospered . . . and the utilization of extracted steam from the generator units for heating the business district and public buildings is an advantage in Northern Minnesota measured beyond dollars and cents!

Detroit Lakes' order for a Worthington 4000 kw automatic bleeder turbine will bring to 7000 kw its total of Worthington installed turbine power. The first Worthington turbine, a 1000 kw unit, was installed in 1933; the second, a 2000 kw unit, in 1937.

The units have been inspected every two years and have been reliable and economical in operation.

Del-Mar-Va's Vienna Station Expands by Six Million



Foundations and turbine room, Vienna Generating Station of Eastern Shore Public Service Company of Maryland (United Engineers & Constructors, Inc., Philadelphia).

To provide more electrical energy to the Del-Mar-Va Peninsula, the Eastern Shore Public Service Company, a subsidiary of the Delaware Power and Light Company, is now undertaking a $6,000,000 expansion of its station in Vienna, Maryland.

Worthington was recently awarded the contract for the condensing unit to serve the latest 15,000 kw Turbo-Generator: a 14,000 sq-ft two-pass condenser with auxiliary equipment.

Four units are now in operation in this station—two 6,000 kw and two 7,500 kw. One 15,000 kw unit is being installed by the United Engineers and Constructors and a similar unit is on order. The two 6,000 kw generators operate at 300 psi, 675F, TT; the 7,500 kw and 15,000 kw units operate at 650 psi, 825F, TT.

NEWS

FROM THE PUBLIC WORKS FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS, FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON

1

NEWS from the public works front

If It Weren't for the Eels, a 38-Year Rec of Attention-less Pumping

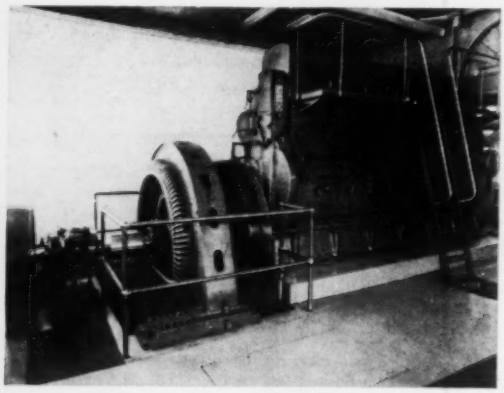
Back in 1909, the Perley Brook Pumping Station of Gardner, Mass., installed a Worthington 12 in. turbine pump, driven by a 200 hp, 1150 rpm motor.

This unit pumps water from the Cowee Pond —an auxiliary reservoir with 200,000,000 gallons storage capacity—into Crystal Lake, the main reservoir. The pump is in operation an average of four months each year, handling approximately 83,000,000 gallons per month.

Mr. Edward V. O'Donnell, the present superintendent, who assisted in the installation of the pump, reports—38 years later—that this Worthington pump has never required any replacement parts or repair work of any description.

It has weathered two floods. After the second one, the pump casing was opened to remove several eels. No other work was required.

Edward V. O'Donnell, Superintendent, shown w 38-year-old Worthington turbine pump at Gardner, Mass. pumping station



Worthington EE-6, 750 hp Diesel engine— Village of Kenyon, Minnesota

Plant Efficiency Up 25% Production Costs Down 55% Power Selling Price Down 40%

Worthington equipment has played an important part in the efficient and economical production of electric power in the municipal plant at Kenyon, Minn. Following is a progress report of this plant, which is now considered a show place among the smaller municipal plants in the Midwest.

In 1932, two 300 hp and one 125 hp Worthington four-cycle engines were installed.

During the first full year, 619,740 kwhr were generated, at 10.14 kwhr per gallon of fuel and at a cost of 2.39¢ per kwhr on t switchboard. Average sale was 4.87¢ per kw

In 1938, 983,220 kwhr were generated, a cost of 1.437¢ per kwhr on the switchbo and average sale was 4.31¢ per kwhr.

Then, in 1939, one 750 hp Worthing four-cycle engine was installed, and the follo ing year showed 1,305,120 kwhr generat 11.98 kwhr per gallon, at a cost of 1.308¢ p kwhr at the switchboard and average sale a lower rate) of 3.7¢ per kwhr.

By the end of 1946, overall plant producti efficiency had reached a rate of 12.76 kwhr p gallon, production cost had dropped to 1.17 per kwhr at the switchboard, and average s (at a still lower rate) had arrived at the low 2.92¢ per kwhr.

Further increased load resulted in purch of a 1440 hp Worthington supercharged u

Thus, in a period of 13 years, plant efficien was increased 25%, from 10.14 kwhr per g lon of fuel to 12.76 kwhr . . . production co decreased 55% from 2.39¢ per kwhr a switchboard to 1.172¢ per kwhr . . . elec power selling price was reduced by 40% fr 4.87¢ per kwhr to 2.92¢ per kwhr.

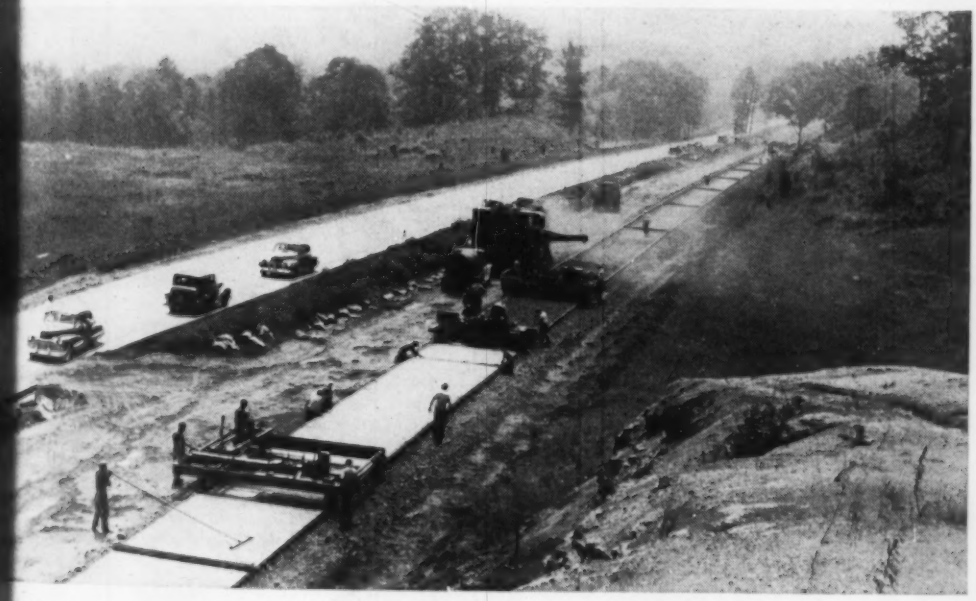
At the time the new equipment was co tracted for, there was no indebtedness on t plant. The entire investment to that date h been paid from the profit on the electric sold to the consumers. There was also a b ance in the treasury in Government bonds \$35,520.00.

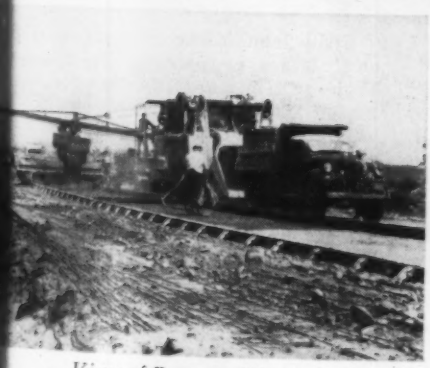
In 1946 a new office and warehouse w erected and a large addition to the generat station to house the new 1440 hp engine a to provide for the new switchboard, and al to provide a new work shop. Revenue certi cates were issued to finance this new constru tion and equipment.

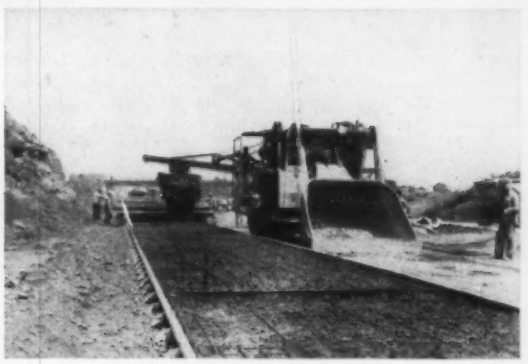
Blue Brute Pavers Pushing Work on Connecticut Super-Highway

has resumed on the Wilbur-Cross High-hich is the great traffic link between ork and New England.
nding from the Merritt Parkway in the estern section of Connecticut, the new tate super-highway will provide a hway from New York to the Massachu-ate line at Union, Conn., carrying non-ercial traffic into the vacation land and ial centers of New England. Present les call for completion in January, 1950. spring contracts for placing a total of feet of 8-inch reinforced concrete nt in the towns of North Haven, Wall-d and Meriden, were placed with L. G. ce and Son at North Haven. This con-used two Ransome 34 E Blue Brute on the job—12 miles of 4-lane park-ch lane 22 feet wide with an 8 ft shoulder. king hard against time, a Ransome 34 Drum Paver poured the North-South link, and a Ransome 34 E Single Drum Paver poured inter-sections and widening strips. Both were equipped with the hydraulically-controlled boom and bucket combination that has made the Ransome paver a faster-laying, more versatile machine.

Originally, the contractor's batching plant was set up to meet the requirements ordinarily required by such a job, the plan being for the Dual Drum to pour the bottom layer, and the Single Drum the top layer. After the job was started, however, it soon became apparent that the pace set by the two Blue Brutes was too great for the batching plant. As a result, the Ransome Dual Drum paver was given the job to do alone, which it did at an average rate of 2800 feet per day, and 3100 feet during one single day run—an on-the-job confirmation of the fact that, for pure economy and time-saving paver operation, only a Ransome can compete with a Ransome.







Views of Ransome Blue Brute Pavers in action on new Wilbur-Cross Highway

Worthington Pump and Machinery Corporation

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Harrison, N. J.

John Budd Wentz, assistant city manager of Long Beach, Calif., was the central figure in an article, "City Manager's Assistant," published recently in *The Saturday Evening Post*. The article was accompanied by two pages of color photographs, showing Mr. Wentz working at various aspects of his job. He had several years' experience as a marine engineer and naval architect before joining the Navy, from which he was released as a lieutenant in October 1946. His work in Long Beach has included analysis of airport leases and contracts, a study of municipal salaries in six nearby towns, institutional reorganization at the dog pound, a refuse disposal survey, a bus survey to determine loading time and peak load facts, the article points out.

John B. Wentz

Harold K. Palmer, formerly principal hydraulic and electrical engineer for the Los Angeles County Sanitation District, has established a private consulting practice in Los Angeles. He will specialize in hydraulics, water conservation, sewage disposal, pumping plants, irrigation and sludge gas utilization.

Urban D. Gosselin is newly named assistant to the president of F. H. McGraw & Co., engineering and construction firm of New York and Hartford, Conn. Mr. Gosselin has been with the company since 1935.

Jean H. Knox, chief engineer of the Floridagold Citrus Corp., Lake Alfred, Fla., was the subject of an editorial recently in the Winter Haven *News Chief* commending him for his community work, including the designing of a high school stadium in Lake Alfred, a reinforced concrete structure seating 5,000 persons, constructed at an approximate cost of $8 per seat.

W. P. Feeley, president of the Great Lakes Dredge & Dock Co., Chicago, has been elected president of the River and Harbor Improvement Association, Washington, D.C.

Clyde L. Palmer, associate in the City Engineer's Office, Detroit, Mich., in charge of sanitation, recently was appointed lecturer in civil engineering on the staff of the University of Detroit engineering school.

J. McCree Smith announces the opening of an office in Raleigh, N.C., for the general practice of civil engineering.

Carl Crandall has been appointed acting director of the school of civil engineering at Cornell University, succeeding the late **William Lindsay Malcolm,** director. **Howard M. Gifft,** associate professor, has been named assistant to Professor Crandall.

Herbert S. Thomson, Jr., is now deputy director and chief engineer of foreign operations for the Greek War Relief Association at Athens. He is in charge of a $6,735,000 project for rehabilitation of health stations, schools and hospitals.

T. W. Ogilvie, of Lassen, Calif., has been appointed Lassen County road commissioner, in addition to his work as county engineer.

Ellis L. Armstrong, engineer for the Bureau of Reclamation, is now construction engineer for the Bureau in charge of the $38,000,000 Culbertson Dam project on the Republican River in Nebraska, which is being constructed by the Bureau of Reclamation as part of the Missouri Basin Project. He will be located at Trenton, Nebr. Mr. Armstrong previously was in the Denver office of the Bureau.

Deceased

James Henry Millar Andrews (M. '16) former vice-president in charge of engineering for the Philadelphia Transportation Co., Philadelphia, Pa., died in that city on February 10. He was 72. Mr. Andrews joined the company (then the Philadelphia Rapid Transit Co.) in 1903. He was made assistant to the president in 1929, chief engineer in 1939, and vice-president in 1943.

H. Foster Bain, who has been serving in the Philippines as adviser on mining to President Manuel A. Roxas and the late President Quezon, died at Santo Tomas Hospital, Manila, on March 9. Dr. Bain, who was 76, was secretary of the American Institute of Mining and Metallurgical Engineers from 1925 to 1931.

Shirley Baker (M. '08) consulting engineer of San Francisco, died in Palm Springs, Calif., on February 10. Mr. Baker, who was 74, had had a consulting practice in San Francisco for many years. An early engineering graduate of Stanford University, where he was a friend and classmate of former President Hoover, he was one of the engineers engaged on the construction of the huge Stanford stadium. He served in the Army Corps of Engineers in the first World War.

Roy Hamilton Beattie (M. '09) president of the Beattie Marine Engineering Corp., of Fall River, Mass., died at his home at Tiverton, R.I., on February 21. Mr. Beattie, who was 77, had an engineering and contracting practice in Fall River from 1917 on. His engineering projects included sections of the Providence municipal wharf and sea walls at East Providence and Somerset, Mass. He was assistant director of the wooden ship division of the Emergency Fleet Corp. in World War I, and during the recent war designed many of the naval installations in the Narragansett Bay area.

Harry T. Daniels (Assoc. M. '21) died in Wilmington, Del., on January 16, at the age of 62. He was a division engineer in the design division of E. I. du Pont de Nemours & Co., Inc., with which he had been connected since 1936. He had served as assistant project engineer in the design division, project engineer, and assistant supervising engineer. Prior to his connection with the du Pont Co., he was for some years with the Grasselli Chemical Co., Cleveland, Ohio.

Isaac DeYoung (M. '10) retired engineer, died at his home in Wenonah, N.J., on February 2, at the age of 77. Mr. DeYoung spent most of his career at Sault Ste. Marie, Mich., where he was successively junior engineer, assistant engineer and engineer in the U.S. Engineer Office. He has also been general superintendent of the St. Mary's Falls Canal at Sault Ste. Marie and consultant to the city engineer of Sault Ste. Marie. He retired in 1945.

James Pelton Gallager (Assoc. M. '11) died on February 5 at a Little Rock, Ark., hospital. His age was 76. At the time of his death, he was assistant engineer of plans and surveys for the Arkansas State Highway Commission, with which he had been associated for the past 20 years. He previously was with the Midland Valley Railroad at Muskogee, Okla.

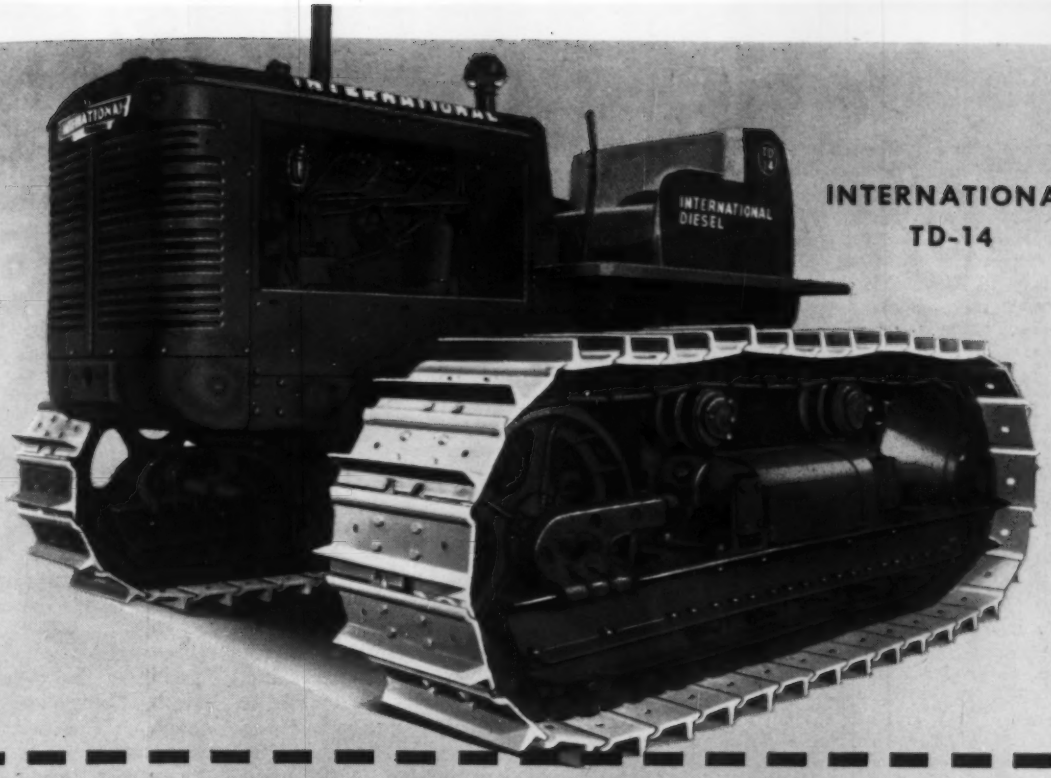
Henry F. Jonas (M. '07) member of the Houston, Tex., engineering and architectural firm of Jonas & Tabor, died on January 31, at the age of 80. For some years Mr. Jonas was engineer of structures for the Southern Pacific Line at Houston, and he had served as supervising engineer on the construction of the Galveston Causeway. He had been in engineering practice in Galveston for the past 20 years.

Lee Jutton (M. '45) president of the Jutton-Kelly Co., of Milwaukee, Wis., died in a hospital there on February 21. His age was 67. From 1903 to 1922 Mr. Jutton was with the Chicago & North Western Railway, serving successively as draftsman, bridge inspector, division engineer and trainmaster. In the latter year he organized the heavy construction firm of Jutton-Kelly, which specialized in the construction of bridges, locks and dams.

Richard Mansfield Merriman (M. '20) construction engineer of Pasadena, Calif., died at his home there on February 9, at the age of 65. Mr. Merriman was at one time construction manager for Ulen & Co. in Athens, Greece, and later served as division superintendent of the Metropolitan Water Division of Southern Calif., at Los Angeles. More recently he was in private practice as a construction engineer there. In his earlier years, Mr. Merriman worked on Canadian railways and designed amusement park structures in that country. He had also been with the government of Puerto Rico as engineer in charge of municipal work for 70 municipalities of the island and, at one time, did railway location work in South America.

Ervin John Miller (M. '42) since 1936 chief bridge engineer for the Minnesota Highway Department, Minneapolis, Minn., died at his home there on January 21. He was 60. Mr. Miller began his engineering career with the Minneapolis Park Board, was an instructor in engineering for the student army training corps from 1917 to 1919 at the University of Minnesota, his alma mater, and was Hennepin County bridge engineer from 1919 to 1921. He was on special bridge assignment for the State Department before becoming chief bridge engineer.

(Continued on page 74)



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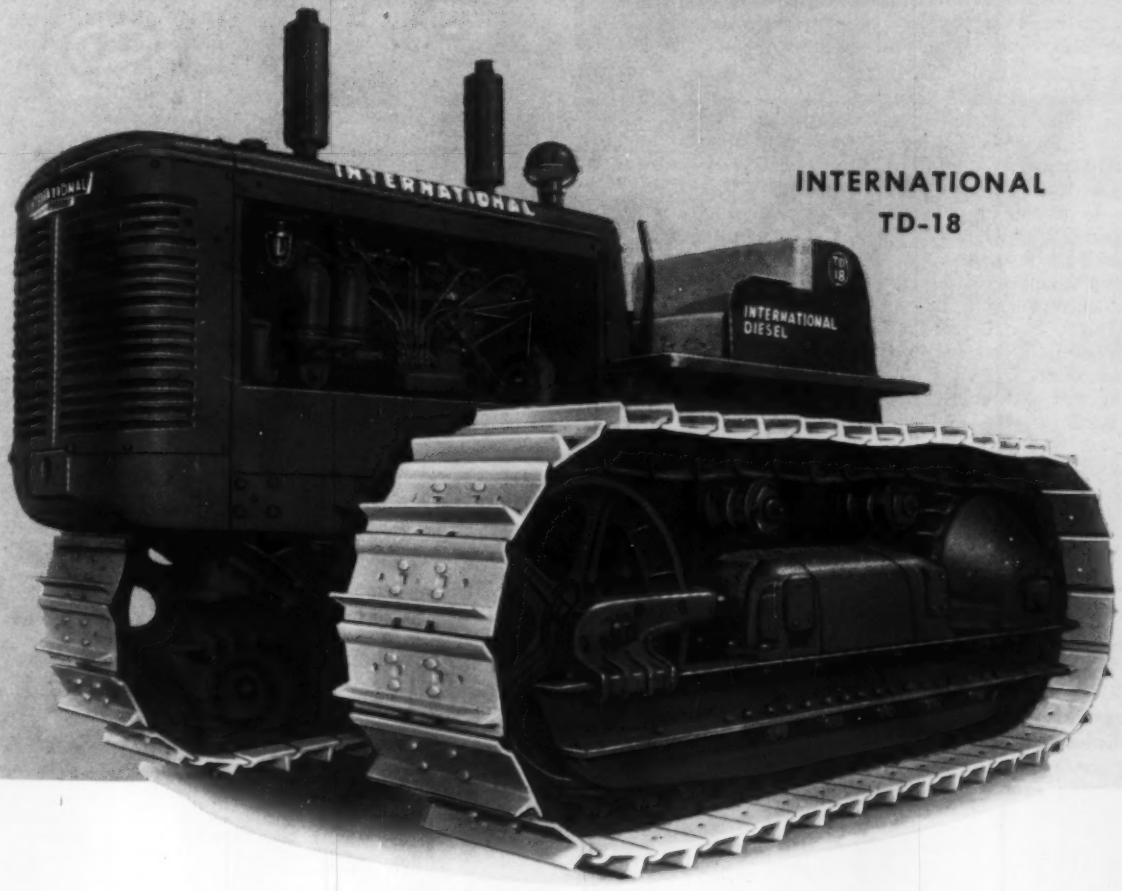

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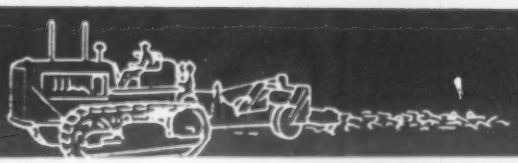
Industrial Power



Clyde Philip Parkinson (Assoc. M. '41) died recently at his home in Toledo, Ohio, where he was associated with the engineering firm of Jonas & Henry. His age was 37. Mr. Parkinson was a camp engineer for the U.S. Forest Service from July 1933 to February 1935, when he became assistant project engineer for the Iowa State Highway Commission on the supervision and inspection of bridge construction. He became a junior hydraulic engineer for the U.S. Geological Survey in August 1936, and four years later was made assistant hydraulic engineer.

John Calvin Riddell (Assoc. M. '32) managing partner of the Peterson Construction Co., Salina, Kans., died suddenly in his office there on February 9. He was 48. Mr. Riddell was associated with the Gordon Walker Construction Co. for eight years, joining the Kansas State Highway Commission in 1932 as a resident engineer. He later was an assistant division engineer in charge of construction. He became a civilian engineer on War Department construction in 1941, and was commissioned a captain in the Corps of Engineers in November 1942. During his five years of military service he rose to the rank of lieutenant colonel and was in charge of construction of airfields, cantonments and ordnance plants.

Emmet Abner Steece (M. '04) retired civil engineer of Washington, D.C., died at his home in that city on February 15, at the age of 78. Mr. Steece served several terms as city engineer of Burlington, Iowa, and from 1906 to 1910 was chief inspector on the construction of the Great Lakes Naval Training Station in Chicago. From 1910 until his retirement in 1940 he was construction engineer in the supervising architect's office of the Treasury Department. After World War I his headquarters were in Washington, where he supervised construction of the Veterans' Administration Building and of two Department of Agriculture buildings.

China Rebuilds Her Railroads

(*Continued from page 35*)

with the railroads, but to supplement them so as to feed additional traffic to the railroads. As in the past, agricultural products constitute the principal source of traffic. Further, the development of mining and industry under the first and successive five-year plans will eventually provide substantial additional traffic to the railroads.

In view of these facts, it is evident that the railroad industry in China has a bright and promising future for earning profit. The extent of this profit, of course, will depend on the capacity of each line; some will require the building of additional track and purchase of additional rolling stock and/or installation of modern signal equipment. Above all, the production of railroad business will depend entirely on the political and economic stability of the country. On the other hand, political unity and economic prosperity cannot be reached without the active functioning of the railroads, as the two are interdependent.

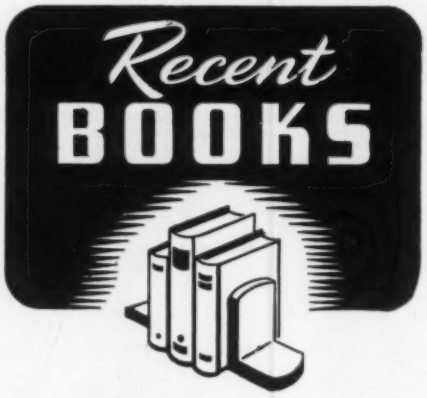
High Early Strength Cement Proved Structurally Sound

(*Continued from page 40*)

near Pittsburgh, Pa. High early strength cement, used in key sections of the arch ribs, gained enough strength in 12 hours to withstand stresses due to the temperature effect on the steel falsework. Ten days of curing time was saved on each of the ten arch ribs, or 100 days in all. As $700 of the contractor's daily fixed payroll on this job was non-productive while the arch-rib concrete cured, the total saving was $70,000. A recent inspection showed the concrete to be still in fine condition.

In watertight and exposed structures, high early strength cement has a good record for durability and density. The Stamford, Conn., Yacht Club's salt-water swimming pool, concreted with this type of cement in 1930, is still giving excellent service.

The Tampa, Fla., Union Terminal, built in 1928 of dock piling and deck slab construction, represents another type of exposed structure adapted to the use of this cement. Concrete piles for the terminal, lifted three days after casting, were driven to refusal 24 hours later. Dock work followed immediately, with forms stripped in one-third the usual time. The job was completed 21 days sooner that it could have been using ordinary cement, thus saving $10,000 in overhead and rentals. Engineers of the present owner, the Gulf Florida Co., Inc., report no damage to the structure from sea water or sea growths, the piling and the concrete deck being in excellent condition today. Further information on this subject is available in booklet form from the Lone Star Cement Corp., through whose courtesy the accompanying illustrations and data on high early strength portland cement are used.



AMERICAN SOCIETY FOR TESTING MATERIALS, Proceedings, Vol. 46, 1946. Committee Reports, Technical Papers. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1947. 1629 pp., illus., diagrs., charts, tables, 9¼×6 in., cloth, $12; to A.S.T.M. members, $8. This volume presents the committee reports and the technical papers presented at the 49th annual meeting. All the symposia are not presented in full. Those published elsewhere are summarized. Discussions are included and immediately follow the respective papers. A wide variety of materials and material properties is dealt with.

ARCHITECTURAL CONSTRUCTION, THE CHOICE OF STRUCTURAL DESIGN. By T. Crane. John Wiley & Sons, New York; Chapman & Hall, London, 1947. 414 pp., illus., diagrs., charts, tables, 9¾×6¼ in., cloth, $6. Of interest to practicing architects and architectural engineers as well as to students, this volume presents a procedure for determining the most suitable basic structural elements for a particular structure. It is intended to fill the void between a descriptive study of materials and types of construction and the final design of individual structural elements. A comprehensive résumé is made of all the better types of construction now available in the American market, with recommendations concerning their specific applications. Many diagrams, tables, and photographs illustrate the text.

CLAY PIPE ENGINEERING MANUAL. Clay Sewer Pipe Association, Inc., Columbus 15, (1105 Huntington Bank Bldg.) Ohio, 1946. 159 pp., illus., diagrs., tables, maps, 9¼×6 in., cloth, $3. Containing engineering reference data applicable to the design of sewers, drains, and other construction projects in which clay pipe is used, this volume provides a practical reference source for the engineer, constructor, or user. Sanitary sewer systems and storm water drainage systems are discussed. Subsoil, roadway, airport, and railroad drainage systems are considered. A section is included on commonly used constants and tables.

COMBAT SCIENTISTS. By L. R. Thiesmeyer and J. E. Burchard; volume editor, A. T. Waterman; foreword by K. T. Compton. Little, Brown and Co., Boston, 1947. 412 pp., illus., tables, 8¾×5½ in., cloth, $5. This book tells the story of the field activities of the Office of Scientific Research and Development as instituted and carried out for the purpose of providing the armed forces with scientific advice on new weapons, devices and techniques. The many forms of this assistance, its scope, and a glimpse of the manner in which this activity was organized and operated are presented. Two illustrations of the work are given in the studies dealing with the navigational and demolition aspects of landing operations. Subject and personnel indexes and a glossary of organization and operation abbreviations are included.

DATA BOOK FOR CIVIL ENGINEERS, Volume 3, Field Practice. By E. E. Seelye. John Wiley & Sons, New York; Chapman & Hall, London, 1947. 306 pp., illus., diagrs., charts, tables, 8½×5½ in., cloth, $4.50. The third in a series entitled *Data Book for Engineers*, this volume is designed to equip the field engineer or inspector for the proper inspection of virtually every type of civil engineering work. It contains outlines of inspection procedure and check lists on concrete, masonry, structural steel, welding, bridges, foundations, pile-driving, timber, soils, grading, bituminous paving, sanitary construction, and pipe laying. Material on the conducting of field tests is presented as well as a detailed discussion of surveying practice.

ENGINEERING TESTS: CIVIL, MECHANICAL AND ELECTRICAL. (Arco Civil Service Series.) By A. Liebers. Arco Publishing Co., New York, 17 (480 Lexington Ave.), 1947. 49 pp., Civil Engineering Test Questions, Sample Examinations, 24 pp., diagrs., tables, 10½×8 in., paper, $2.50. This volume presents a careful selection of Civil Service engineering tests with answers, for the use of those who wish to enter public service. The various types of examination questions are demonstrated, acceptable work methods are indicated, and sample examinations with the time limits are included for self-checking.

(*Continued on page 78*)

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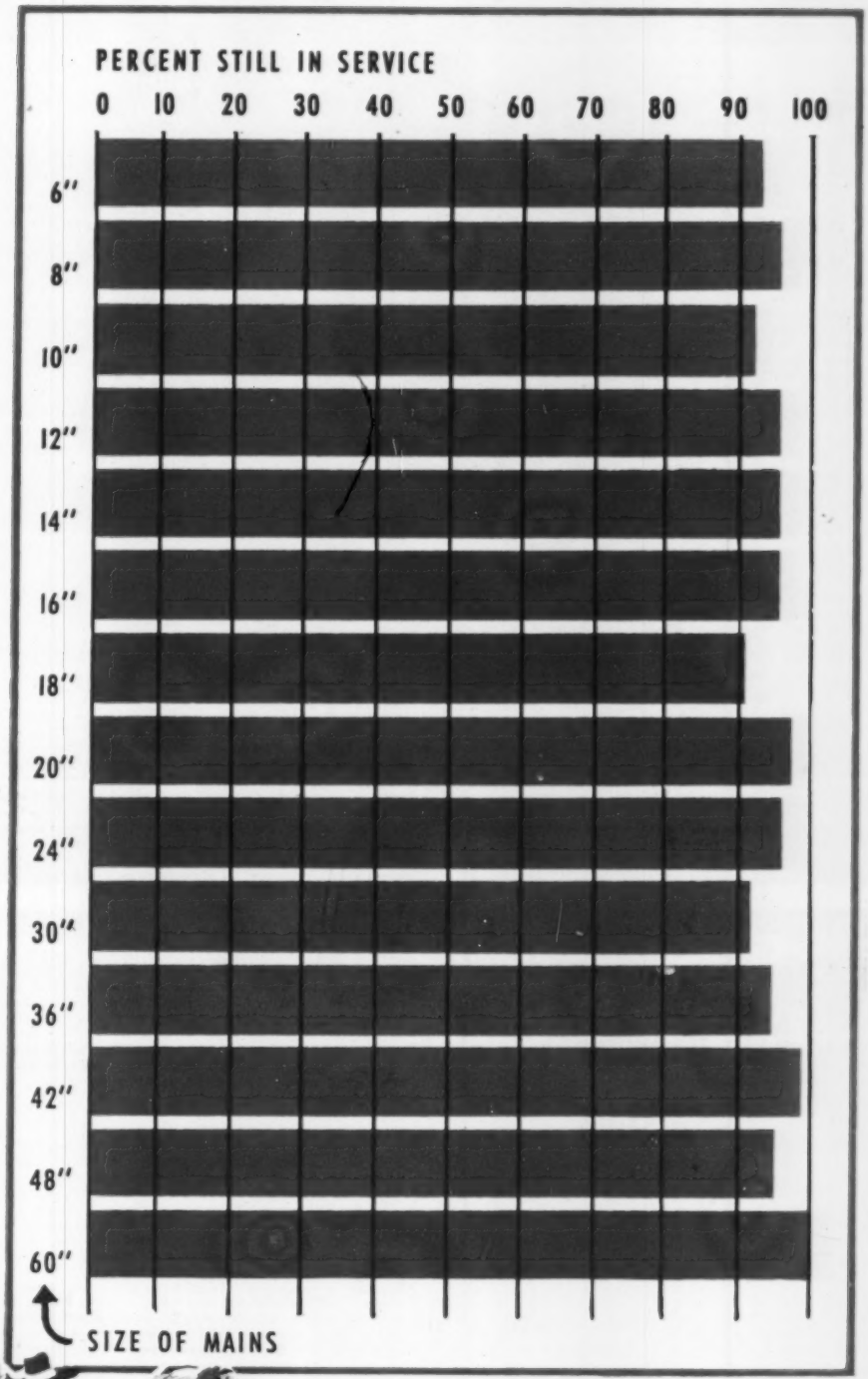

SERVES FOR CENTURIES

(Continued from page 74)

COMPRESSED AIR HANDBOOK, Applications, Equipment, Engineering Data and Test Procedure. Compressed Air and Gas Institute, New York (90 West Street), 1947. 387 pp., illus., diagrs., charts, tables, 9×6 in., cloth, $3. This volume is an authoritative guide for the proper installation, use, and maintenance of air compressors and air-actuated equipment. Divided into five parts, the first presents a graphic account of the many common uses of compressed air. The types of machinery used for compressing air are illustrated and described in part two, while part three is devoted to a discussion and illustrations of air-operated devices and mechanisms. Suggestions and data on the selection, installation, operation, and care of the compressed air plant are given in part four. The final section contains engineering data and standards established by the Compressed Air and Gas Institute.

ELEMENTS OF RAILROAD ENGINEERING, 6 ed. By W. G. Raymond, H. E. Riggs, and W. C. Sadler. John Wiley & Sons, New York; Chapman & Hall, London, 1947. 442 pp., illus., diagrs., charts, tables, 9×5¾ in., cloth, $5. The sixth edition of this standard text has been revised and, where necessary, rewritten to include information in line with current practice, particularly with regard to speeds, curves, grades, track structure, division points, and terminal facilities. Two new chapters have been added on streamlined trains and on power and passenger equipment. The four major sections cover the following topics: the railroad industry in general; permanent way; the locomotive and its work; railroad surveys.

FACTUAL COMMUNICATION. By L. O. Guthrie. The Macmillan Company, New York, N. Y., 1948. 433 pp., tables, diagrs., charts, 8¾×5¾ in., cloth, $3.50. Emphasis is placed in this book on the need for practical uses of English in the preparation of articles, talks, business letters and reports. Second accent in the volume is put upon the way to find information, especially by students of engineering, science and business. Helpful guides to location and use of essential reference material, such as the Engineering Index and Thomas' Register of American Manufacturers, are included.

FUNDAMENTALS OF ENGINEERING MECHANICS. By A. Sloane. Prentice-Hall, Inc., New York, 1947. 379 pp., diagrs., tables, 9¼×6 in., cloth, $5.65. This volume deals with the usual material on statics and dynamics which is treated in a text on engineering mechanics. In addition, the principle of virtual work, Mohr's circle as applied to moments of inertia and products of inertia, and a brief introduction to the subject of mechanical vibrations have been included. More attention than usual is given to engineering kinematics. The text is constructed as a guide for the student to stimulate thinking instead of learning by rote.

GEOLOGICAL STRUCTURES AND MAPS, a Practical Course in the Interpretation of Geological Maps for Civil and Mining Engineers. By A. Roberts. Sir Isaac Pitman & Sons, Ltd., London, 1947. 66 pp., diagrs., charts, maps, 9¾×7 in., cloth. 12s. 6d. Providing a survey of elementary geology, this book is designed to meet the needs of civil and mining engineers whose work entails the interpretation of geological maps. It contains a graded series of exercises in geological mapping. Some of the more important simple structures are illustrated by block diagrams. The graphical method is used in all dip and strike problems.

GROUND WATER, ITS DEVELOPMENT, USES AND CONSERVATION. By E. W. Bennison with foreword by W. M. Bollenbach. Published by Edward E. Johnson, Inc., St. Paul, Minn., 1947. 509 pp., illus., diagrs., charts, tables, 9½×6 in., cloth, $2.25. This volume, consisting of a series of articles which originally appeared in the *Johnson National Drillers' Journal* from 1940 to 1946, presents the basic principles of groundwater hydrology and well construction. The techniques in common use in developing and pumping ground water and its subsequent treatment are considered, as well as methods of conservation. Not intended as a scientific treatise, the book provides a wide range of practical information for the well driller or water supply engineer.

INDUSTRIAL HEALTH ENGINEERING. By A. D. Brandt. John Wiley & Sons, New York; Chapman & Hall, Ltd., London, 1947. 395 pp., illus., diagrs., charts, tables, 9¼×5¾ in., cloth, $6. Beginning with a discussion of industrial atmospheric contaminants and their significance, this volume proceeds to describe the principles of control available and the types of equipment used: collectors, exhaust systems, respirators, etc. Design data and other aspects of interest to the practical engineer are included. The later chapters deal briefly with ventilation, air conditioning, radiant energy, industrial illumination, industrial noise, and plant sanitation. There is a twelve-page bibliography.

LIGHT METALS IN STRUCTURAL ENGINEERING. By L. Dudley. Temple Press Ltd., London, 1948. 216 pp., tables, diagrs., graphs, 8¾×5¾ in., cloth, $6.50. This book is designed chiefly to give those engaged in work involving use of light alloys a knowledge of the characteristics and possibilities of these materials and to aid in applying such knowledge in design calculations. The book covers much of the ground within the scope of the examinations, in the "strength of materials" given by professional engineering institutions. While calculus has been used in explanation of many of the theories contained in the book, an understanding of it is not essential in enabling the reader to solve most of the various problems analyzed.

PRINCIPLES OF INDUSTRIAL MANAGEMENT. 4th ed. By E. A. Allcut. Sir Isaac Pitman & Sons, Toronto, Canada, 1947. 308 pp., illus., diagrs. charts, tables, 9¼×6 in., cloth, $4. Intended, for use by students as a text, this volume does not attempt to describe the details of industrial administration. After a discussion of the general principles of management, the specific topics of organization, reports, purchasing, budgets, planning, work routing, and stockroom procedures are treated. A chapter on time and motion study is included as well as chapters on inspection, costs and cost keeping, industrial labor relations, and waste.

RAILWAYS OF SWITZERLAND (14th International Railway Congress, Lucerne, June 1947). Railway Gazette, 33 Tothill Street London, S.W.1, 1947. 87 pp., illus., diagrs., charts, maps, tables, 12×9 in., paper, 5s. Issued in connection with the 14th International Railway Conference held at Lucerne in June 1947, this publication covers the more important aspects of the development of the Swiss railway system and the policy of railway nationalization. Technical topics discussed include track, track railways, tunnels, signaling, rolling stock, and electric, steam, and internal combustion traction. The publication is generously illustrated by maps, photographs, etc.

RECORDS AND RESEARCH IN ENGINEERING AND INDUSTRIAL SCIENCE, 2 ed., rev. & enl. By J. E. Holmstrom. Chapman & Hall, Ltd., London, 1947. 366 pp., diagrs., charts, tables, 8½×5½ in., cloth, 21s. Of interest to those who use technical knowledge in their work, this volume shows how to obtain information concerning the work the rest of the world is doing in any field. It shows how data may be collected from technical sources, how to integrate facts and ideas, and how to transmit these facts and ideas to those who need them. Other topics discussed are the nature and methods of technical science, the principles of technical translation, and the various organizations, particularly British, that issue publications themselves or abstract the work of others.

SCALE MODELS IN HYDRAULIC ENGINEERING. By J. Allen. Longmans, Green and Co., London, New York, Toronto, 1947. 407 pp., illus., diagrs., charts, maps, tables, 8¾×5½ in., cloth, $8.50. This book presents a survey of the techniques, advantages, and limitations of hydraulic model experiments. "Dynamical similarity" and its general implications in fluid mechanics are discussed, and scale model investigations of river problems are described. Two classes of problems are considered, the one involving only the flow of water between or over fixed boundaries; and the other the phenomena of erosion and accretion. Detailed references to the sources of data are included.

SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS, Proceedings, Vol. 5, No. 1, edited by C. Lipson and W. M. Murray. Society for Experimental Stress Analysis, Central Square Station, Cambridge 39 (P.O. Box 168), Mass.; published and distributed by Addison-Wesley Press, Inc., Kendall Square, Cambridge 42, Mass., 1947. 136 pp., illus., diagrs., charts, tables, 11½×8½ in., cloth, $6. The fifteen papers contained in this volume deal with various aspects of the following subjects: strain gages; impact testing; telemetering; X-ray analysis; fatigue and other stresses. Also included are a list of members and contents pages for Vols. II, III and IV.

STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING, 5 ed. Part I. Specifications, 272 pp. Part II. Methods of Sampling and Testing, 361 pp. Adopted by American Association of State Highway Officials, Washington, D.C., 1947. Illus., diagrs., charts, tables, 9¼×6 in., cloth, $6 per set. Volume I of this compilation presents specifications for Highway materials classified under the following headings: hydraulic cement; bituminous materials; aggregates; brick; expansion joint fillers and asphalt plank; culvert and sewer pipe; bridge paints; reinforcing steel and wire rope; metallic materials for bridges; and miscellaneous. A total of 104 specifications is given, including two new and thirteen revised ones. Volume II covers standard methods of sampling and testing highway materials, again classified under the same headings with the important addition of soil testing. As a result of revision and simplification, all the test procedures are now in almost complete agreement with those issued by the American Society for Testing Materials. Three new standards bring the total in the present volume up to 106. Lists of specifications and standards in numerical sequence are included.

STRUCTURAL ENGINEERING, 5 ed., rev. and enl. By J. Husband and W. Harby. Longmans, Green and Co., London, New York, Toronto, 1947. 591 pp., diagrs., charts, tables, 8¾×5½ in., cloth, $6. This volume presents the principles of the design of steel, masonry, plain and reinforced concrete structures. Applications of these principles are given in detailed designs of the more commonly occurring structures. The new material included in this fifth edition is devoted to the principles and design of reinforced concrete construction. The general properties of structural materials and the structural analysis of beams and slabs, columns and footings, retaining walls, tanks and reservoirs are fully discussed. An appendix contains many useful charts and tables.

SURVEYING INSTRUMENTS, Their History and Classroom Use. By E. R. Kiely. Columbia University, Bureau of Publications, Teachers College, New York, 1947. 411 pp., illus., diagrs., charts, tables, 9¼×6 in., cloth, $3. The first half of this book is devoted to description of the instruments and methods developed during the period of time from ancient Egypt, China and Babylonia up through Renaissance Europe. The following chapter discusses the development in recent years of instruction in practical geometry and mensuration in the schools as opposed to purely classical treatment. Basic applications of geometry and trigonometry in simple surveying are presented as detailed problems, mainly selected from old practical geometries. A 20-page bibliography is included.

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APPLICATIONS FOR ADMISSION OR TRANSFER

April 1, 1948 Number 4

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every Member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid it in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board. Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years
Associate Member	Qualified to direct work	27 years	8 years	3 year
Junior	Qualified for subprofessional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years

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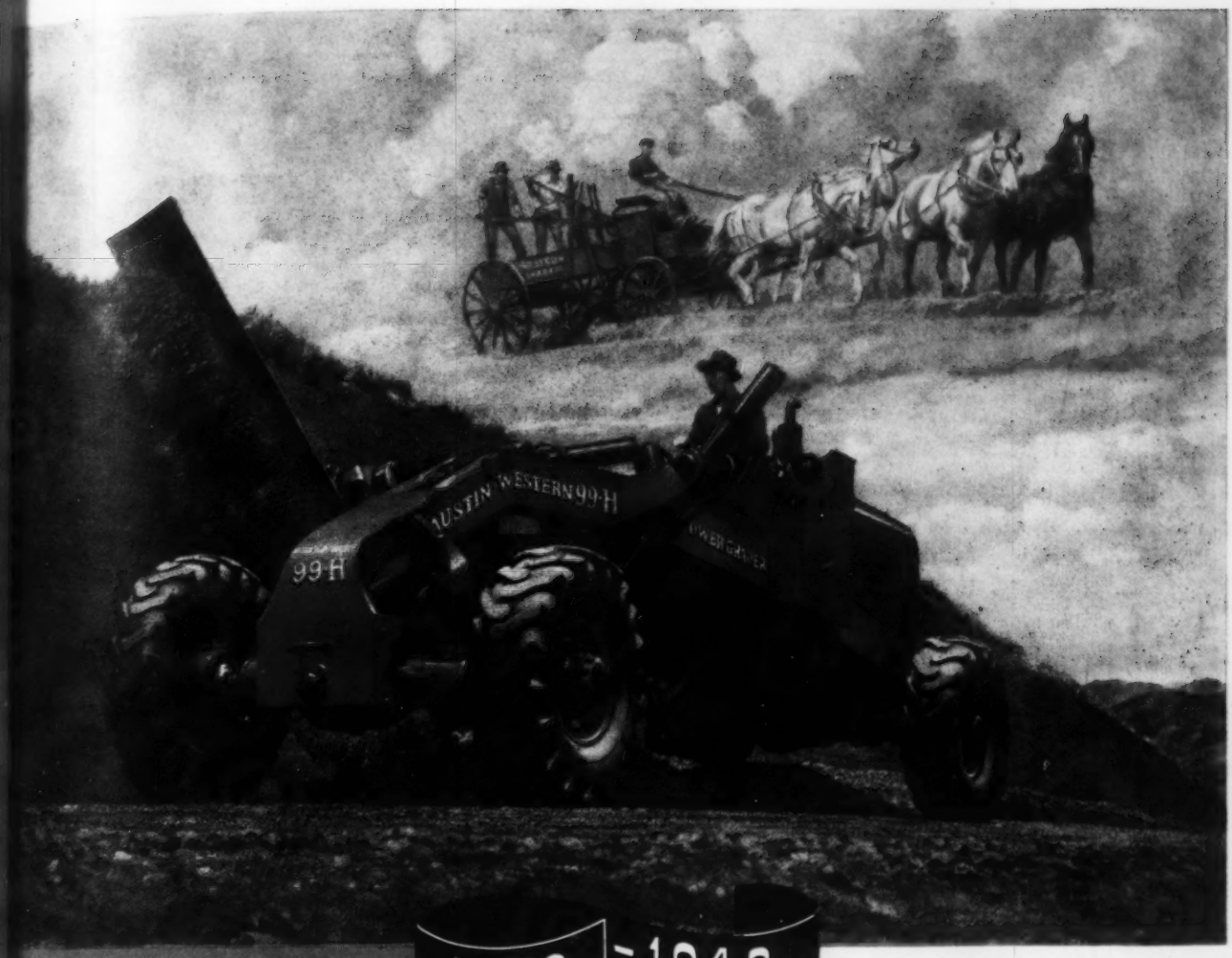

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KANE, DAVID (Jun.) (Age 33) Design Draftsman, Ford, Bacon and Davis, Inc., New York, N.Y.

KLEIN, FRANCIS BURT (Jun.) (Age 34) Structural Engr., Parsons Aerojet Co., Los Angeles, Calif.

KNOENER, CHARLES JOHN (Age 43) Dist. Mgr., The Pitometer Co., Engrs., Albany, N.Y.

KRICKENBERGER, CUSTER FRANKLIN, JR. (Jun.) (Age 28) Lt. (j.g.), CEC, U.S. Navy, Asst. Officer in Chg. of Constr., Noy 13360, Fairbanks, Alaska.

LAYSON, JOHN DON (Jun.) (Age 34) Asst. City Engr. and San. Engr., Stockton, Calif.

LIBERSHAL, FRANCIS MEISINGER (Age 31) with Ernest Rokahr & Sons, Gen. Contrs., Lincoln, Nebr.

LIPSON, SAMUEL FLOYD (Jun.) (Age 34) Assoc Prof. of Civil Engineering, Univ. of British Columbia, Vancouver, B.C., Canada.

MATHES, ELLIS LEROY (Jun.) (Age 35) Traffic Engr., Idaho Bureau of Highways, Boise, Idaho.

MILLER, WALLACE TYRRELL (Age 43) Engr., Water Resources Branch, U.S. Geological Survey, Portland, Ore.

MILLER, WILLIAM ELLSWORTH (Jun.) (Age 35) Asst. to Wm. L. Miller, Engr. and Land Surveyor, Wading River, N.Y.

MOELLER, CLIFFORD MERRILL (Jun.) (Age 34) Asst. Prof., Dept. of Civil Engineering, Montana State Coll., Bozeman, Mont.

MORRIS, EDGAR LONGETTE (Age 36) Col., Corps of Engrs., U.S. Army (Reserve) C.O., 1148th Engr. Combat Group, Senior Engr. Reserve Comdr. in South Carolina, Columbia, S.C.

MURRAY, GEORGE GORDON (Age 47) Prin. Engr., Moffatt and Nichols, Inc., Consulting Engineers, 707 S. Hill St., Los Angeles, Calif.

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NORDENSON, TOR JULIUS (Jun.) (Age 34) Hydrologic Engr., U.S. Weather Bureau, Procedure Development Sec., Washington, D.C.

PEREZ, JESUS PEREZ (Age 35) Tech. Director and Partner, Ingenieriay Servicio Industrial, Lomas, Mexico, D.F.

PETERS, EDWARD RUSSELL (Age 36) Constr. Engr., Jones & Laughlin Steel Corp., Cleveland, Ohio.

PETERS, IREDELL W. (Age 48) Sales Engr., Tennessee Culvert Metal Co., Knoxville, Tenn.

PHELAN, PAUL FREDERICK (Jun.) (Age 35) Prin. Highway Engr., Koppers Co., Inc., Pittsburgh, Pa.

PIERCE, GUY ELLSWORTH (Jun.) (Age 35) Senior Bridge Engr., Sacramento County, Sacramento, Calif.

RAJAN, GOPALASAMUDRAM AIYASWAMI NATA (Age 27) Res. Engr. in charge of maintenance, American Airfield at Ondal, E. I. Ry., India.

RANDALL, THOMAS DUDLEY (Jun.) (Age 34) Civ. Engr., D. M. McBean, Inc., Cons. Engrs., Rochester, N.Y.

RITTER, ANDERSON BASIL (Age 43) Public Health Engr. I, State Health Dept., Regional Engr., Lafayette, La.

SCHIPKE, JOHN HENRY, JR. (Jun.) (Age 34) Structural Engr., General Mills, Inc., Minneapolis, Minn.

SHAHAN, EVERETT TERRY (Jun.) (Age 34) Dist. Civ. Engr., Humble Oil & Refining Co., Grand Isle, La.

SHAMSUDDIN, MOHAMMED (Age 30) Graduate student, Dept. of Civ. Eng., Brooklyn Polytechnic Inst.; previously Engr. in charge Mecca-Madina Alladin Endowment Bldgs., Hyderabad, Deccan, India.

SHARAGA, FRED (Age 38) Superv. Engr., Dept. of Water Supply, Gas & Elec., New York, N.Y.

SIMPSON, ROBERT EDWARD (Jun.) (Age 34) Materials Engr., Grade P-3, U.S. PRA, being Materials and Maintenance Engr., Utah Dist. Office, Ogden, Utah.

SMITH, HENRY FRANKLAND (Age 33) Civ. Engr. (Structural and Hydraulics), City of Tacoma, Wash.

STEENHILL, NIELS KOLD (Jun.) (Age 33) Supt., The Rust Eng. Co., Waterville, Me.

SWANSON, HERBERT SIXTUS (Age 52) Jun. Structural Engr., "B" Dept. of Water and Power, City of Los Angeles, Calif.

TERRASS, JOHN MILFORD (Age 53) Bridge Engr., Coast Lines, Atchison, Topeka & Santa Fe Ry. Co., Los Angeles, Calif.

TEUFEL, GEORGE ILLINGSWORTH (Jun.) (Age 34) Supt., George E. Teufel Co., Contrs., Seattle, Wash.

TILDEN GEORGE FREDERICK WEITZEL (Age 48) Structural Engr., Kansas City Structural Steel Co., Kansas City, Mo.

TSAI, CHUN-HSIANG (Age 32) Chf., Hunan Regional Office, National Water Power Survey, National Resources Comm. of China; at present studying, planning and designing of hydro-electric projects with Fargo Eng. Co., Jackson, Mich.

WALKER, JOHN DELOS (Age 31) Asst. Head, Engineering Planning Branch, Corps of Engrs., Portland, Ore.

WEBB, GEORGE MAURICE (Age 48) Senior Highway Engr., California Div. of Highways, Sacramento, Calif.

WEBB, WILBUR CALEB (Age 34) Building Maintenance Supervisor II, City of Milwaukee, Wis.

APPLYING FOR JUNIOR

ADAMS, DONALD EVANS (Age 24) Sales Engr., The Hallen Co., Inc., Long Island City, N.Y.

AZRI, SHAMSHAD (Age 25) Grad. Student, Columbia Univ., New York, N.Y.

BROACHA, FIROZE HORMUSJEE (Age 23) Structural Designer, Jackson & Moreland, Engr., Boston, Mass.

BROADY, HARRY WILLIAM (Age 26) Field Engr., Stone and Webster Eng. Co., New York, N.Y.

DAUGHERTY, HAL LAVOID (Age 29) Engr. (Civ.) P-2, U.S. Engr. Office, Mobile (Ala.) District, Spring Hill, Ala.

DE ARRIETA, JOHN (Age 29) Engr. P-3 with Corps of Engrs., Sacramento Dist., Sacramento, Calif.

GARFINK, MALCOLM OFTEBRO (Age 27) Instructor in Applied Mechanics and Structural Design, Wentworth Inst., Boston, Mass.

GRANSTROM, MARVIN LEROY (Age 27) Instructor in Civ. and San. Eng., Case Inst. of Technology, Cleveland, Ohio.

GREEN, HAROLD CHRISTIAN (Age 30) Asst. Civ. Engr., Postwar Planning and Acquisition Program, Sacramento, Calif.

HAINES, SAMUEL EARLE, JR. (Age 24) Construction Inspector, under the Engineer of Bridges, Reading Railroad, Reading Terminal, Philadelphia, Pa.

HENDRICKSON, JOHN GRIFFITH, JR. (Age 29) Asst. Prof., Dept. of Civ. Eng., Princeton Univ., Princeton, N.J.

KLICHE, ENRIQUE ALBERTO (Age 28) Engr., Direction of Sanitation, Ministry of Public Works, Montevideo, Uruguay.

MACLEAN, DUART ALAN (Age 26) Asst. Hydraulic Engr., Comptroller, Water Rights Branch, Dept. of Lands and Forests, Victoria, B.C., Canada.

NAGLER, JOE JOHN (Age 27) Structural Engr. with Wyatt C. Hedrick, Archt.-Engr., Dallas, Tex.

NICHOLS, JOHN RUSSELL (Age 22) Civ. Engr. (Jun.) with L. A. Steens, Engr. & Contr., Cape Town, South Africa.

OWEN, EDWARD POWELL (Age 24) at present graduate student, Univ. of Texas; previously with Corps of Engrs., U.S. Army, Jacksonville, Tex.

PADHI, ANANDA CHANDRA (Age 23) at present candidate for Sc.D. at Mass. Inst. Tech. Graduate House, M.I.T., Cambridge, Mass.

PANCHANATHAN, SWAMINATHA (Age 23) Graduate Student, Columbia Univ., New York, N.Y.

PREECE, FERA ROBERT (Age 25) Junior Engr. with Bethlehem Steel Corp., Los Angeles, Calif.

SAIAS, GUY ADRIEN (Age 23) Graduate student, Univ. of Michigan, Ann Arbor, Mich.

SIEBERT, HARRY JOHN (Age 28) Sales Engr. Neptune Water Co., New York City, having charge of sales in North Carolina and South Carolina, Charlotte, N.C.

SOUBA, WILEY WILLIAM (Age 27) Instructor, Civ. Eng. Dept., Washington State Coll., Pullman, Wash.

SUTHERLAND, HUGH BROWN (Age 28) Research Associate in Soil Mechanics, Harvard Univ., Cambridge, Mass.

WEIL, NICHOLAS ANDREW (Age 22) Graduate student, Univ. of Illinois; also Asst., under Prof. Wilson on Strength of Joints, in Copper, Univ. of Illinois, Urbana, Ill.

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Engineering Facts about

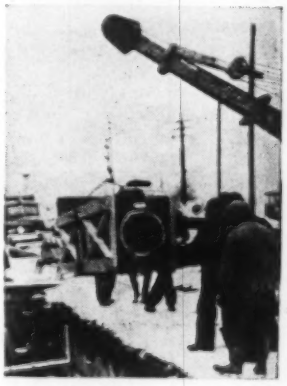
Johns-Manville TRANSITE PRESSURE PIPE

*Winnipeg: A case history**

In 1932 the city of Winnipeg, Manitoba, made its initial installation of Transite Pressure Pipe. A portion of the installation consisted of an 18" line. Recently this pipe was subjected to a series of field and laboratory tests to determine its condition after 14 years of service, which had included exposure to an extremely corrosive soil.

Pitometer Flow Test

Before the pipe was removed from the line for the laboratory tests which were to follow, its flow capacity was checked. The Pitometer Company, Inc., New York, was selected to conduct these field tests. Velocities ranged from 1.1 to 1.9 feet per second and readings were made at 30-second intervals. During each test, the velocity was held constant. Results were summarized by the Pitometer Company as follows:



Assembly of pipe and coupling being removed from the line for laboratory tests.

"The high value of C-140, which we believe is a reliable index of the present capacity of the pipe tested, shows that there has been little if any loss in capacity since 1932 when the pipe was laid."

Readings being recorded during Pitometer flow tests on the line.

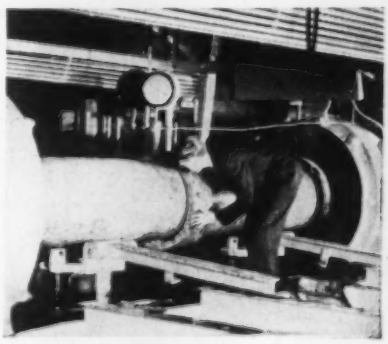
Soil Conditions

The soil in which this Transite installation was made was known to be destructive to water pipe. Analysis showed the presence of certain soluble salts, which, when dissolved by ground water, became highly corrosive.

It was desired, therefore, to determine how well the Transite line had withstood these severely corrosive conditions and thereby to provide a basis for gauging its life expectancy. To do this, a series of physical tests were made, using the sections of pipe which had been removed from the line for the purpose. The most significant of the tests conducted on the pipe were the hydrostatic pressure tests.

Hydrostatic Pressure Tests

In order to simulate field conditions as closely as possible, an assembly consisting of portions of two lengths of pipe joined by a Simplex Coupling with rubber rings and sleeve intact was tested. The complete assembly was placed in a hydrostatic testing machine and the water pressure was raised to 260 pounds per square inch. This was the original test pressure to which this pipe had been subjected at the factory and 4 times the normal working pressure of the line.



Assembly of pipe and coupling undergoing hydrostatic pressure test.

Pressure was held at 260 pounds while observers closely examined the coupling for leakage. No leakage occurred. The rubber rings, undisturbed and in their original position, functioned as well as when the pipe had been placed in service 14 years previously. Subsequent careful inspection and tests confirmed that the rubber rings removed from this Transite line were free from any signs of deterioration.

Specimens of the Winnipeg pipe were also subjected to other laboratory tests. Crushing tests showed that its strength compared favorably with that of Transite Pressure Pipe as manufactured today. A corporation stop pull-out test provided further verification that the strength of this pipe was in no way impaired.

Summary

The above series of tests provided conclusive evidence that the strength, flow capacity and other physical characteristics of the Winnipeg pipe were unimpaired after 14 years' service under severe conditions. Further, as summarized in the original report, they demonstrated that "on the basis of the performance rendered to date, it is reasonable to anticipate a life-expectancy of many times that already obtained."

* *A copy of the detailed performance report on this Transite Pipe installation is available on request. Address Johns-Manville, Box 290, New York 16, N. Y.*

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MILLER, WILLIAM RUSSELL, 1948 (22)
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PARK, DAN MCFARLAND, 1948 (30)
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RANEY, DONALD RAYMOND, 1948 (24)
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DITTIG, ROGER GEORGE, JR., 1948 (24)
FISHER, WILMER L., 1948 (25)
JERMAN, DANIEL LEE, 1948 (25)

McGILL UNIV.

FORGUES, ROBERT, 1947 (21)

UNIV. OF MD.

SUTCLIFFE, DRAPER KRUM, 1948 (25)
UPDEGRAFF, JAMES EDWARD, JR., 1948 (26)

MASS. INST. TECH.

CARROLL, FRANK EDWIN, 1947 (25)
ENGLEMANN, WILLIAM CHARLES, 1948 (26)

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YALE UNIV.

LAWRENCE, GERALD RONALD, 1948
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The Board of Direction will consider the applications in this list not less than thirty days after date of issue.

CHANGES IN MEMBERSHIP GRADES

ADDITIONS, TRANSFERS, REINSTATEMENTS, AND RESIGNATIONS

From February 10 to March 9, 1948

Additions to Membership

ALEXANDER, GEOFFREY NEWMAN (Assoc. M. '47) "Forsythia," Bayview Rd., Belgrave, Victoria, Australia.

ALINEU, HERBERT NATHAN (Jun. '47) Civ. Engr., Devenco, Inc., 150 Broadway, New York (Res., 1437 Carroll St., Brooklyn 13), N.Y.

APPLETON, JOSEPH HAYNE (Jun. '48) Special Research Graduate Asst., Univ. of Illinois, 105 Talbot Laboratory, Urbana, Ill.

ARONSON, HARVEY (Jun. '47) Engr., Black, Sivalls & Bryson; 2601 North Walker, Apt. 4, Oklahoma City, Okla.

ARTHUR, JOHN MANNING (Jun. '48) Eng. Asst., State Highway Dept. (Res., 411 West Hullum), Breckenridge, Tex.

BAIGAS, JOSEPH FREDERICK, JR. (Jun. '47) Junior Civ. Engr. San., Dept. of Public Works, New York City, Wards Island (Res., 15 Hillcrest St., Staten Island), N.Y.

BAILEY, JOSEPH SPENCER (Jun. '47) Field Engr. Portland Cement Assn., Boston Bldg., Denver 2, Colo. (Res., 3504 Dey Ave., Cheyenne, Wyo.)

BALZER, DONALD JOSEPH (Jun. '47) 2617 North Lexington St., Arlington, Va.

BARRETT, JAMES MANNING (Jun. '48) Draftsman II, City Engr.'s Office (San Diego), Civic Center (Res., 1560 Union St.), San Diego 1, Calif.

BECKER, ELMER WILLIAM (Assoc. M. '48) Civ. Engr. III, City of Milwaukee, City Hall, Milwaukee, Wis.

BELL, FRANK MONTGOMERY (Assoc. M. '48) Head, Soils Section., Div. Materials Testing Laboratory, South Atlantic Div., Corps of Engrs., Dept. of Army, P.O. Box 51, Marietta, Ga.

BELT, ROBERT MCCOLL (M. '48) Supt., Dept. of Public Works, P.O. Box 162 (Res., 2055 Makiki St.), Honolulu 4, T.H.

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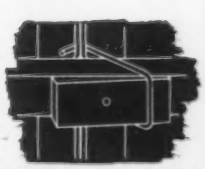

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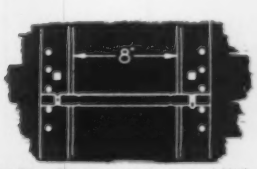

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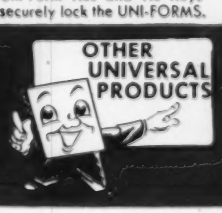

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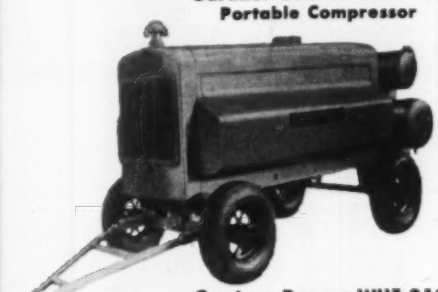

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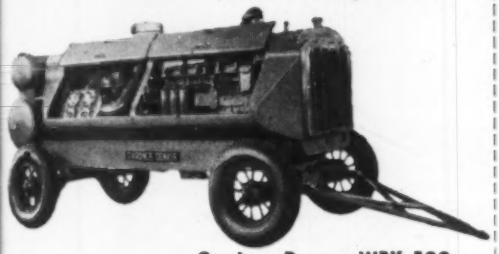

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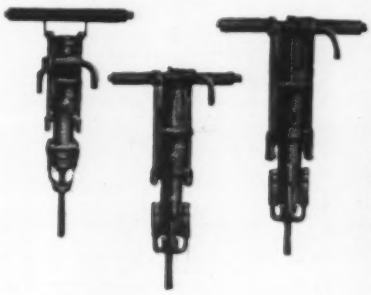

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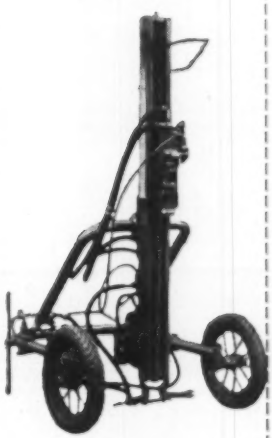

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(Continued from page 88)

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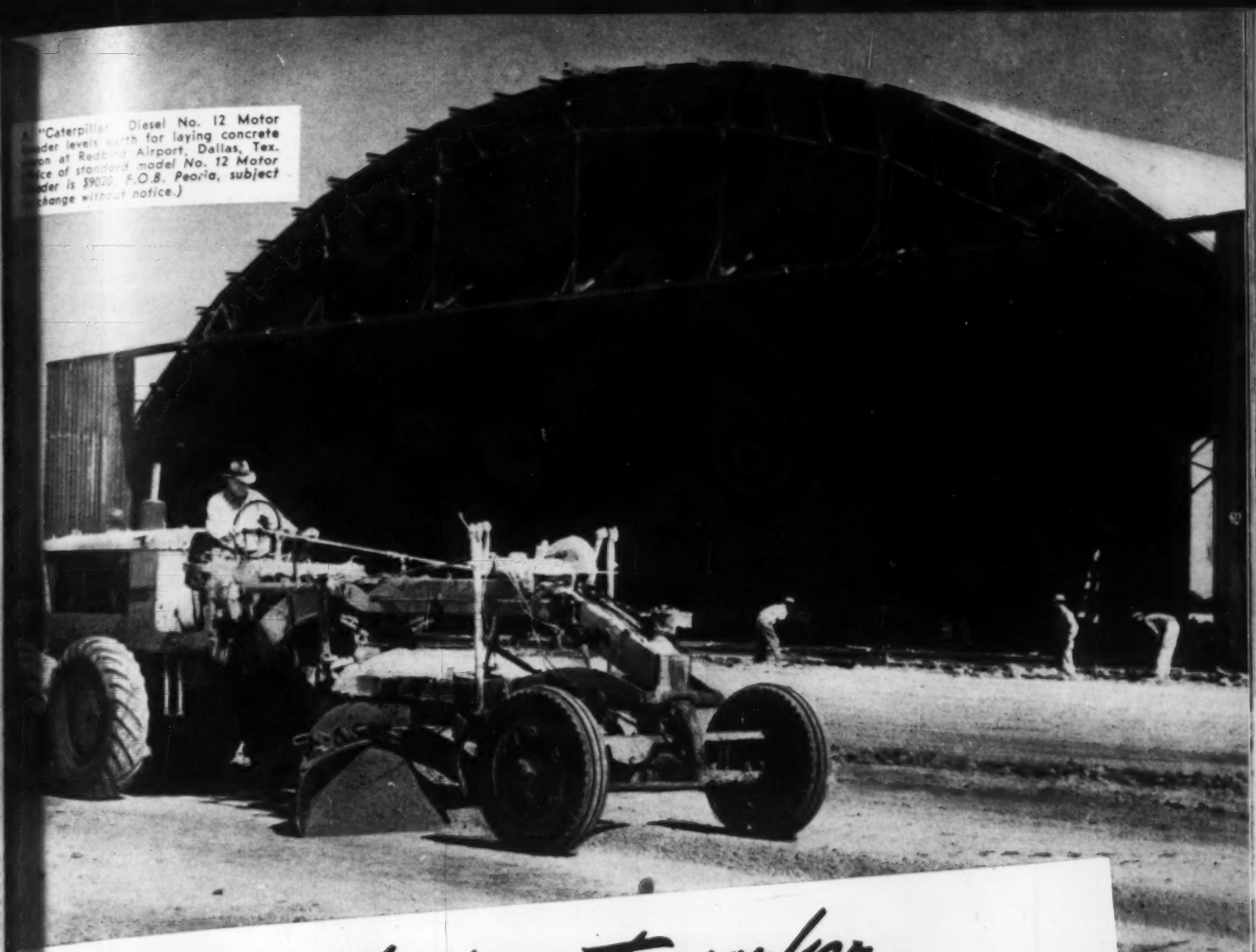

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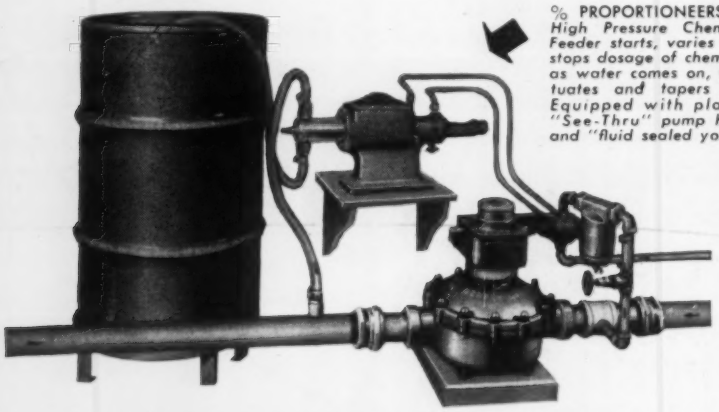

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HINSHAW, CARL (Assoc. M. '43; M. '48), Member of Congress, House of Representatives, 1511 House Office Bldg., Washington, D.C.

HYDEN, BAILEY SYLVANIUS (Jun. '38; Assoc. M. '47) Civ. Engr. (Private), R-3, Box 866, Dallas 10, Tex.

JORDAN, EDWARD CLARENCE (Jun. '34; Assoc. M. '48) (H. I. & E. C. Jordan), 31½ Exchange St., Portland 3, Me.

KURKCIYAN, SIMON YETVART (Jun. '36; Assoc. M. '47) Arnavut-Koy, Ceviz Sokak, No. 6, Istanbul, Turkey.

LAWRENCE, FRED FORREST (Jun. '35; Assoc. M. '48), Hydr. Engr. (P-3), Conservation Branch U.S. Geological Survey, 410 Federal Bldg. (Res. 1505 North Alder St.), Tacoma 6, Wash.

LEHMAN, FREDERICK GOODWIN (Jun. '38; Assoc. M. '48) 65 Bowden Rd., Cedar Grove, N.J.

LYNCH, JAMES ALVIN, JR. (Jun. '38; Assoc. M. '48) (Lynch Constr. Co., Gen. Bldg. Contr.), 730 East Gage Ave., Los Angeles 1, Calif.

MATTHEWS, MEDWIN (Jun. '23; Assoc. M. '29; M. '48) Designing Engr., N.Y.C. Board of Water Supply, 120 Wall St., New York, N.Y.

MAXWELL, GEORGE HENRY (Jun. '37; Assoc. M. '48) Civ. Engr., Am. Bemberg Corp. and North American Rayon Corp. (Res., 606 Hattie Ave.), Elizabethton, Tenn.

MERCHANT, WILFRED (Jun. '38; Assoc. M. '47) Lecturer in Structural Eng., College of Technology, Manchester (Res., 158 Claremont Rd., Salford 6, Lancashire), England.

MCCABE, JOSEPH, Brother, F.S.C. (Jun. '42; Assoc. M. '48) Asst. Prof., Manhattan College, New York 63, N.Y.

MORRIS, ROBERT KESSLER (Jun. '42; Assoc. M. '48) Civ. Engr., Alden E. Stilson and Associates, 209 South High St. (Res., 931 Kenwick Rd., Columbus 9, Ohio.

MULHOLLAND, ANDREW NEWELL (Assoc. M. '20; M. '48) Asst. Div. Engr., Board of Water Supply, City of N.Y., 120 Wall St., N.Y. (Res., 6 Bronx River Road, Bronxville), N.Y.

PATRICK, JAMES GEORGE (Jun. '39; Assoc. M. '48) Div. Soil Engr., Corps of Engrs., North Pacific Div., 500 Pittock Block, Portland 5, Ore.

PETERSEN, CARROLL CLAYTON (Jun. '41; Assoc. M. '48) Field Engr., American Bridge Co., Frick Bldg. (Res., 6358 Marchand St.), Pittsburgh 6, Pa.

PETRULLO, CARL FRANK (Jun. '36; Assoc. M. '47) Engr., The Albert Boyer Constr. Co., 236 Queen St. (Res., 385 Fourth St.), Northumberland, Pa.

PHIPPS, FRANCIS HARLOE (Jun. '20; Assoc. M. '28; M. '48) Civ. Engr., Dept. of Public Works, Municipal Bldg., New York (Res., Care. W. C. Phipps, 102 South 6th Ave., Mount Vernon), N.Y.

RIGGS, EUGENE HOWARD (Assoc. M. '41; M. '48) City Mgr., City of El Monte, 630 South Tyler Ave. (Res., Box 668), El Monte, Calif.

RIGGS, HENRY CHILES (Jun. '40; Assoc. M. '48) Associate Hydr. Engr., U.S. Geological Survey, 207 Federal Bldg., Tacoma 2, Wash.

RIVES, JAMES ALLEN (Assoc. M. '47) Associate Prof. of San. Eng., Virginia Polytechnic Inst. (Res. Box 452), Blacksburg, Va.

ROGGINS, LOUIS BENJAMIN (M. '48) Civ. Engr., Board of Water Supply, 120 Wall St., Room 1201, New York, N.Y.

RUDDELL, RONALD HOLMES (Assoc. M. '20; M. '48) Supt. of Constr., Cia Chilena de Electricidad Limitada, Casilla 66-V, Valparaiso de Chile, S.A.

SAWCHUK, HENRY AVERY (Jun. '39; Assoc. M. '47) Staff Adviser (Eng.), U.S. Civil Service Comm., Washington, D.C. (Res., 2412 Fifty-Ninth Place, Cheverly, Md.)

SEELY, GEORGE HERMAN (Jun. '27; Assoc. M. '36; M. '48) Res. Engr., Creole Petroleum Corp., Cumarebo, Estado Falcon, Venezuela

SEIM, MAYNARD CLIFFORD (Jun. '35; Assoc. M. '48) Structural Engr., Great Lakes Steel Corp., Stran Steel Div., 3750 Penobscot Bldg. Detroit (Res., 36108 Ford Rd., Route 2, Wayne) Mich.

SEUFER, PAUL ERNEST (Jun. '39; Assoc. M. '47) Lt.-Comdr., CEC, U.S.N., Office of Superintending Civ. Engr., Area VI and VII, Hdq. Bldg., Western Seafrontier, Naval Station Treasure Island, San Francisco (Res., 525 Guinda St. Palo Alto), Calif.

SHELFORD, JOHN (Jun. '39; Assoc. M. '47) Structural Engr. in Chg. of Structural Eng., Public Works Office, Washington Navy Yard 8th and M. S.E. (Res., 105 Joliet St., S.W.), Washington 20, D.C.

SMITH, WALTER PRESTON (Jun. '37; Assoc. M. '48) Asst. Highway Engr., Dist. IV, State Div. of Highway, 2001 Van Ness Ave. (Res., 320 Walnut St.), San Francisco 18, Calif.

SPENCER, ERNEST LINCOLN (Jun. '41; Assoc. M. '47) Asst. Prof. of Civ. Eng., Northeastern Univ., Boston (Res., 58 South St., Medfield), Mass.

TER MAATH, BERNARD HERMAN (Jun. '39; Assoc. M. '48) Chf. Engr., Byrne-Moline Communities, Inc., Box 360 (Res., 1723 Fifth St.), Moline, Ill.

THOMA, EDWARD CHARLES (Jun. '38; Assoc. M. '48) Asst. Prof. of Civil Eng., Purdue Univ., Civil Eng. Bldg., Lafayette (Res., 237 Connelly St., West Lafayette), Ind.

TONEY, MARTIN (Jun. '34; Assoc. M. '48) Asst. Engr. of Design, Bridge Div., Arizona Highway Dept., West Jackson St. (Res., 333 West Cortinado Rd.), Phoenix, Ariz.

UPP, PHILIP ALFRED (Jun. '27; Assoc. M. '30; M. '48) Bridge Designer, Matthews & Kenan, 1604 Transit Tower (Res., 2514 South Presa), San Antonio, Tex.

WHITE, MERIT PENNIMAN (Jun. '36; Assoc. M. '40; M. '47) Prof. of Civ. Eng., Univ of Massachusetts, Amherst (Res., Whately), Mass.

WILLIS, ROBERT MILLS (Assoc. M. '31; M. '48) Engr. of Design, State Highway Commission of Kansas (Res., 1925 MacVicar), Topeka, Kans.

WOODRUFF, RICHARD SHAUL (Jun. '37; Assoc. M. '48) Engr., Eng. and Constr. Dept., Alabama Power Co., 600 North 18th St. (Res., 637 Nineteenth Ave. South), Birmingham 5, Ala.

Reinstatements

BOUSFIELD, JAMES, M., Civ. Engr., Board of Water Supply, 120 Wall St., New York (Res., 8837 One Hundred Thirty-Eighth St., Jamaica), N.Y., re-admitted Jan. 12, 1948.

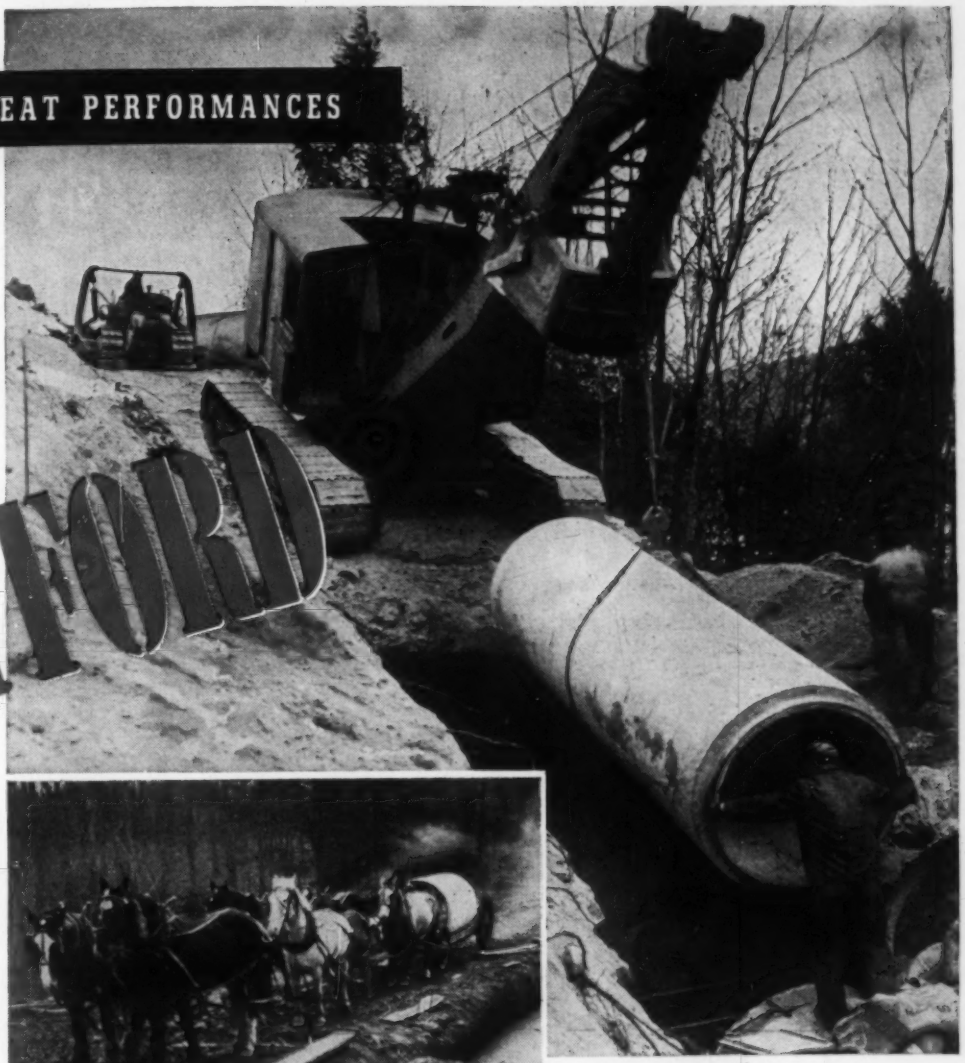
BYRNE, WILLIAM EUGENE, Assoc. M., Civ. Engr., Assoc., Bureau of Standards Dept. of Public Works, City of Los Angeles, 826 Yale St. (Res., 918 Beacon Ave.), Los Angeles, Calif., readmitted Jan. 12, 1948.

CRANFORD, ELMO LEAVINES, Assoc. M., Office Mgr.

LOCK JOINT REPEAT PERFORMANCES

HARTFORD

9 JOBS SINCE 1918



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1918 – Left: Delivery of 48" pipe by six horse team.

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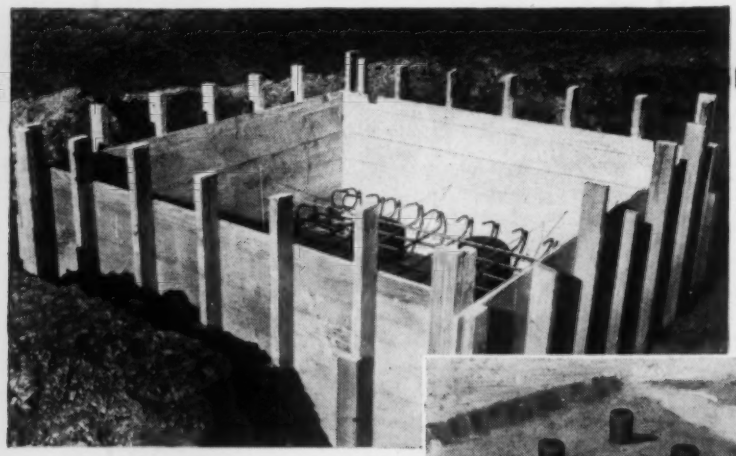

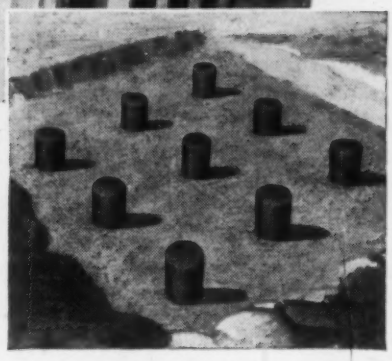

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HANGER, KENNETH HARROW, M., Chf. Eng., Missouri-Kansas-Texas Lines, 1526 Ry. Exchange Bldg., St. Louis 1, Mo., readmitted Jan. 12, 1948.

JONES, PAUL STEVENSON, Jun., Asst. Highway Engr., Dist. VII, State Div. of Highways (Res., 136 Glen Summer Rd.), Pasadena 2, Calif., reinstated Feb. 20, 1948.

NEWCOMER, ALBERT WALDO, Assoc. M., Engr., U.S. Bureau of Reclamation (Res., Route 8, Box 665), Denver 15, Colo., reinstated Feb. 20, 1948.

PARKS, LORNE CLEMENT, Assoc. M., Sales Engr., Texas Ry. Equipment Co., Box 2002, Houston 1, Tex., reinstated Feb 9, 1948.

QUINE, THOMAS ARTHUR, Jun., With U.S. Bureau of Reclamation, Bldg. 1A, Room 160, Denver Federal Center, Denver, Colo., reinstated Mar. 1948.

SPADA, JOHN ANTHONY, Assoc. M., Clearance Insp., New York Central R.R., 466 Lexington Ave., New York (Res., 83 Locust Ave., Scarsdale), N.Y., readmitted Feb. 16, 1948.

Resignations

BEEBE, JOHN RICHARD, Jun., 1832 Hazel Ave., Kalamazoo 37, Mich., resigned Feb. 10, 1948.

BRANNAN, JOHN HAYES, Assoc. M., 5443 Graceland Ave., Indianapolis 8, Ind., resigned Feb. 10, 1948.

ELGIN, ROBERT LEWIS, Assoc. M., The James Foundation, Box 194, St. James, Mo., resigned Mar. 4, 1948.

FAWCETT, PHILIP NORRISON, M., "Southacre," Thurgarton, Notts, England, resigned Mar. 1948.

FLOYD, HAROLD SHEELER, Jun., 173 Cedar Ave., Hawthorne, N.J., resigned Jan., 30, 1948.

FUSCO, JAMES JOHN, 64 Prospect St., Glens Falls, N.Y., resigned Feb. 13, 1948.

GIBSON, WILLIAM CHARLES, Jun., 1609 Hyland St., Lansing, Mich., resigned Feb. 10, 1948.

GRANER, JESSE BLAINE, Jun., 8428 Rindge Ave., Plaza del Rey, Calif., resigned Feb. 25, 1948.

GRAHAM, LYMAN DAVIS, Assoc. M., 1400 Easton Drive, Lakeland, Fla., resigned Feb. 24, 1948.

JACKSON, WALTER MAX, Jun., 64 Pardee Ave., Lancaster, N.Y., resigned Feb. 9, 1948.

KELLAM, WILLIAM EMORY, Jun., 269 Harvard St., Cambridge, Mass., resigned Feb. 11, 1948.

KINNEY, WILLIAM MORTON, Assoc. M., 126 Abingdon Ave., Kenilworth, Ill., resigned Feb. 10, 1948.

LEE, JOHN CLIFFORD HODGES, M., 105 West Monument St., Baltimore 1, Md., resigned Feb. 1948.

LEONARD, CHARLES LEO, JR., Jun., 24 Broad St., Norwalk, Conn., resigned Dec. 31, 1947.

LOGLI, ALBERT JOSEPH, Jun., 1607 North Winnebago St., Rockford, Ill., resigned Feb. 24, 1948.

MCCLELLAN, MERRITT CHARLES, Assoc. M., U.S. Geological Survey, Box 133, Rolla, Mo., resigned Feb. 11, 1948.

MCLAUGHLIN, THOMAS OAKLEY, Jun., Brookside Rd., Spotswood, N.J., resigned Feb. 10, 1948.

MEAD, WARREN JUDSON, Affiliate, Mass. Inst. Tech., 77 Massachusetts Ave., Cambridge 39, Mass., resigned Feb. 24, 1948.

MILLS, EUGENE CLARENCE, M., 2925 Ashby Ave., Berkeley 5, Calif., resigned Feb. 24, 1948.

MURPHY, EDWARD WILLIAM, Jun., 624 East 3d St., South Boston, Mass., resigned Mar. 3, 1948.

NORCROSS, ARCHER RICE, Assoc. M., 151 South Camden Dr., Beverley Hills, Calif., resigned Feb. 9, 1948.

PORTEOUS, ALFRED JOHN, Jun., 4317 East Washington St., Indianapolis 1, Ind., resigned Mar. 1948.

RASMUSSEN, FRED, JR., Jun., Coolville, Utah, resigned Dec. 31, 1947.

SAVITSKY, DANIEL, Jun., 179–181 East 3d St., New York 9, N.Y., resigned Feb. 25, 1948.

SCHLEY, JULIAN LARCROMBE, M., 207 Tunbridge Road, Baltimore 12, Md., resigned Feb. 9, 1948.

SMELSER, PAUL EDWARD, Assoc. M., 10 Hulbert St., Mobile 17, Ala., resigned Feb. 11, 1948.

STALLINGS, JOHN RALPH, JR., Jun., 1165 Grant Ave., Topeka, Kans., resigned Feb. 25, 1948.

STERBA, ANTONIN MESSENGER, Jun., Care, Mellon Inst. of Industrial Research, Pittsburgh 13, Pa., resigned Feb. 25, 1948.

STRANDHAGEN, ADOLPH GUSTAVE, Jun., Instr., Dept. of Eng. Mechanics, Univ. of Notre Dame, Notre Dame, Ind., resigned Feb. 18, 1948.

THOMAS, CLARENCE MERALD, Jun., 100 Kimbel Lane, Oak Ridge, Tenn., resigned Dec. 30, 1947.

WALDRAM, GEORGE JOHNSON, JR., Jun., 332 Stafford St., Washington, Mo., resigned Feb. 10, 1948.

WILSON, LLOYD RICHARD, Assoc. M., Riverview Drive, Brielle, N.J., resigned Mar. 1, 1948.

WOODRUFF, SETH RITCH, JR., Assoc. M., 46[illegible] Hickory St., Omaha, Nebr., resigned Feb. 9, 1948.